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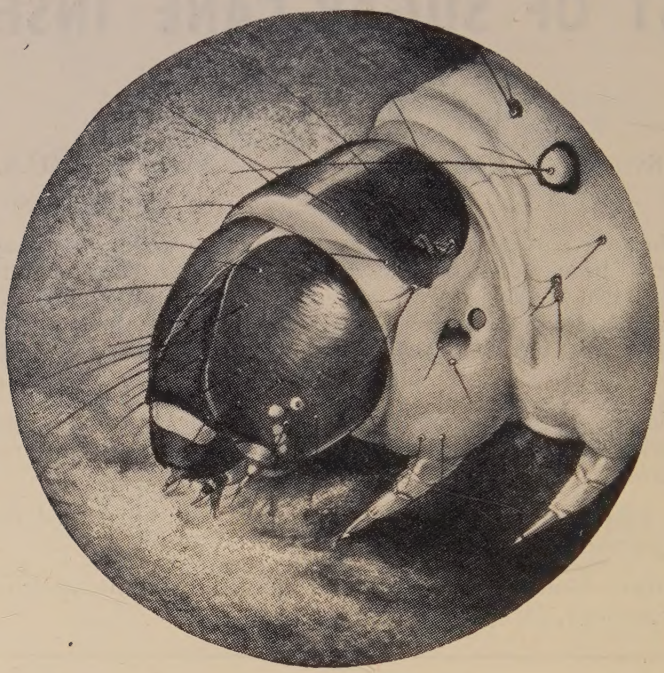

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WAHLIN (B.). **Om kålbladlusens spridning i oljeväxtfält.** [On the Spread of *Brevicoryne brassicae* in Rape Fields.]—*Växtskyddsnotiser* 1952 no. 1 pp. 1–6, 1 fig. Stockholm, 1952.

Brevicoryne brassicae (L.) has recently increased in importance in Sweden as a pest of spring rape, especially that planted in the vicinity of autumn rape. Investigations were made in 1951 on the mode of spread of the Aphid in a field of spring rape next to one of autumn rape and on the effect on it of dusting the spring rape with DDT or a phosphorus compound. The results of the numerous counts are shown in tables. They indicated that the Aphids first colonised plants near the edge of the field and then spread fairly rapidly throughout it, the older colonies dying out or migrating fairly quickly. The number of Aphids in a colony increased as the season advanced, and populations were much greater in the dusted than in the untreated portions of the field. This was apparently due to the elimination of predacious Coccinellids by the dusts.

BEROZA (M.). **Alkaloids from *Tripterygium wilfordii* Hook ; Wilforgine and Wilfortrine.**—*J. Amer. chem. Soc.* **74** pp. 1585–1588, 5 graphs, 11 refs. Easton, Pa., 1952.

Two main alkaloidal fractions remained after the removal of wilforine and wilfordine from the methanol-insoluble fraction obtained from the roots of *Tripterygium wilfordii* [*cf. R.A.E.*, A **40** 204], and two additional insecticidally active alkaloids were isolated from these by partition chromatography employing ultraviolet absorbancy ratios. They were designated wilforgine and wilfortrine, and their purity was established by countercurrent distribution. Their formulae were calculated from molecular-weight, carbon, hydrogen and nitrogen determinations to be $C_{41}H_{47}O_{19}N$ and $C_{41}H_{47}O_{21}N$, respectively, and they were shown to be ester alkaloids, apparently very similar to wilforine and wilfordine, yielding five equivalents of acetic acid, one of 3-furoic acid and two of steam non-volatile acid per mole of alkaloid on saponification. Ultraviolet and infrared absorption spectra of the two alkaloids are given. They were found to be toxic to young larvae of the European corn borer [*Pyrausta nubilalis* (Hb.)].

CHIAROMONTE (A.). *Contarinia sorghicola* **Coq. nel Venezuela.** [*C. sorghicola* in Venezuela.]—*Riv. Agric. subtrop.* **43** no. 4–6 pp. 113–123, 5 figs., 30 refs. Florence, 1949. (With a Summary in English.)

The author records the finding for the first time in Venezuela of *Contarinia sorghicola* (Coq.) on sorghum (*Sorghum vulgare*) and reviews from the literature its bionomics, distribution, food-plants and control in various parts of the world. He states that Walter's record of *C. sorghicola* from Italy [*R.A.E.*, A **30** 365] is erroneous, as the Cecidomyiid is unknown there.

WILLE T. (J. E.). **Entomología agrícola del Perú. Manual para entomólogos, ingenieros agrónomos, agricultores y estudiantes de agricultura.** [Agricultural Entomology of Peru. A Manual for Entomologists, agricultural Technicians, Agriculturists and agricultural Students.]—2nd revd. edn., viii+544 pp., 222 figs., 170 refs. Lima, Junta Sanid. veg., Minist. Agric., 1952.

This second edition of a work on the insects and mites that attack cultivated plants in Peru and their control is similar in scope and arrangement to the first [*R.A.E.*, A **32** 143] but has been enlarged to include the results of more recent investigations in that country. The number of species dealt with has been increased, and the section on chemical control has been expanded to include information on the recently developed synthetic insecticides.

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ELY (R. E.), MOORE (L. A.), CARTER (R. H.), MANN (H. D.) & POOS (F. W.). **The Effect of Dosage Level and Method of Administration of DDT on the Concentration of DDT in Milk.**—BDIM-Inf.-104, 4 pp., 2 graphs, multigraph. Washington, D.C., U.S. Dep. Agric., Bur. Dairy Ind., 1950. **The Effect of Dosage Level and various Methods of Administration on the Concentration of DDT in Milk.**—*J. Dairy Sci.* **35** no. 3 pp. 266–271, 1 graph, 16 refs. Lancaster, Pa., 1952.

These papers, of which the first is virtually a summary of the second, contain the results of experiments in which DDT was administered by various methods and in different quantities to healthy cows that were fed and milked twice daily. Crystalline DDT as such or as a 10 per cent. solution in soy-bean oil was given twice a day in gelatine capsules or in the grain feed and was administered for about 50 days by one method followed by similar periods of administration by other methods. Lucerne hay from crops that had been sprayed in the field was given for periods of 100 or more days, and in a final experiment, the effect was tested of adding the detergents used in the field sprays to the solution administered in capsules. Records were kept of food consumption and milk production and of the amounts of DDT and butterfat in the milk, and the first paper contains three tables showing the effect on DDT concentration in the milk of crystalline DDT applied by each of the four methods, of the oil solution with and without detergents and of DDT residues on the hay. The second paper contains the first two tables.

The cows excreted 5–165 mg. DDT per day in the milk when they ingested 109–727 mg. DDT per day as residue on the hay and only 0·9–75 mg. per day when they received crystalline DDT at 50–2,000 mg. per day, which suggests that intestinal absorption of DDT residue on sprayed forage was more complete than absorption from DDT administered in other ways or that more DDT may be stored in the body fat and less excreted in the milk fat when the crystalline material is supplied. The method of administering the crystalline material and the addition of the detergents to the oil solution had no effect on the concentration of DDT in the milk. Increasing the daily dosage of DDT resulted in comparable increases in the concentration in the milk, and both crystalline DDT and the residue on the hay gave straight-line graphs when plotted against the concentrations in the milk.

LEFÈVRE (P. C.). *Bruchus obtectus* **Say ou bruche des haricots** (*Phaseolus vulgaris* **L.**).—*Publ. Inst. nat. agron. Congo belge* Sér. sci. no. 48, 65 pp., 6 figs., 1 graph, 53 refs. [Brussels] 1950.

Beans (*Phaseolus vulgaris*) are a staple food in the Belgian Congo and Ruanda-Urundi and are seriously damaged by *Bruchus obtectus* Say, the world distribution and food-plants of which are reviewed. The Bruchid breeds continuously in the field, where it is maintained by fallen beans in native plantings, and in the stored beans, and cross-infestation is frequent. Investigations on its life-history in the laboratory at 18–22°C. [64·4–71·6°F.] and 66–76 per cent. relative humidity showed that the preoviposition period and the egg, larval and pupal stages averaged 13, 7, 33·6 and 11·7 days, respectively, so that there might be 5–6 generations a year. The adults survived for an average of 30 days, and the females laid 32–35 eggs each. The optimum temperature was about 30°C. [86°F.] for the immature stages and 27°C. [80·6°F.] for the adults, and the optimum relative humidity was 50–75 per cent. for the eggs, close to saturation point for the larvae and pupae, and about 90 per cent. for the adults. Conditions in warehouses of the European type are more favourable than those in native stores, in which the temperatures and humidities vary more widely from the optimum than in the former, and control measures are necessary.

Different varieties of beans differed greatly in resistance to attack, and the damage was not always proportional to the numbers of adults present.

In experiments, the effect was tested of mixing pyrethrum powder or DDT dusts with the beans, and the profitability of such treatments is considered. Pyrethrum powder (0·89 and 0·85 per cent. pyrethrins I and II, respectively) at 50 gm. per kg. gave high but not complete mortality of adults of *B. obtectus* confined with the treated beans in petri dishes for over 11 days, whereas a dust containing 10 per cent. technical DDT (Geigy 33) at 1 gm. per kg. gave complete mortality in about eight days. In a test lasting 100 days, pyrethrum powder (0·86 and 0·48 per cent. pyrethrins I and II), mixed at rates of 5–100 gm. per kg. with beans of which about 2 per cent. were infested, resulted in 11·5–4·6 per cent. infestation, whereas the DDT powder at 0·5–3 gm. per kg. resulted in 4·75–3·7 per cent., as compared with 12·7 per cent. for no treatment. The DDT treatments were the more profitable, and though even the lowest rate was highly effective, twice this is recommended, in view of the difficulty of mixing such small quantities with the beans. Treatment was then applied to beans harvested two months previously and subsequently sacked. Pyrethrum powder (0·79 and 0·58 per cent. pyrethrins I and II) was used at 5 gm. per kg., and Geigy 33 and another DDT dust, containing 7 per cent. technical DDT, at 1 gm. per kg. Samples were examined once a month, and it was found that the percentage damage had increased from 0·8 to over 4 after nine months for beans treated with pyrethrum powder, the contents of pyrethrins I and II in which had by that time decreased to 0·37 and 0·29 per cent., respectively, whereas both the DDT dusts gave excellent protection for a year (less than 0·5 and 1 per cent. damage, respectively). At the current price of beans, treatment was shown to be unnecessary for those to be stored for five months or less, but desirable for longer periods of storage. The treatment with Geigy 33 did not reduce the germinating power of the beans, and it was shown that the residues on the cooked beans constituted no hazard to consumers.

WALOFF (Z.). **Flight in Desert Locusts in Relation to Humidity.**—*Bull. ent. Res.* **43** pt. 4 pp. 575–580, 1 graph, 12 refs. London, 1953.

The following is largely the author's summary. An analysis of detailed observations on flying swarms of *Schistocerca gregaria* (Forsk.) on 33 occasions in eastern Africa demonstrated an association of intermittent flight with higher and of continuous flight with lower saturation deficits. This association is consistent with recent laboratory studies on the effects of atmospheric humidity on the flight performance of tethered locusts. In a discussion of its relation to the rate of movement of migrating swarms, the author shows that the results support a recent theory by R. C. Rainey that swarms of *S. gregaria* move towards and with areas of convergent air movement and points out the need for considering the effects of humidity and temperature on type of flight in forecasting the probable immediate behaviour of swarms in connection with control operations.

BLETCHLY (J. D.). **A Note on the prepupal Stage and the external Sex Characters of the Pupae of *Anobium punctatum* (Deg.) (Coleoptera, Anobiidae).**—*Bull. ent. Res.* **43** pt. 4 pp. 587–590, 1 fig., 7 refs. London, 1953.

The author describes external characters enabling the male and female pupae of *Anobium punctatum* (Deg.) to be separated from each other and from those of species of related genera. Female pupae of *A. punctatum* are on the average larger and heavier than male, but weight was not found to provide an accurate means of distinguishing between the sexes in the prepupae.

MILES (M.). **Studies of British Anthomyiid Flies.**—*Bull. ent. Res.* **43** pt. 4 pp. 591–596, 1 pl., 4 figs., 4 refs. London, 1953.

In this further part of a series [*cf. R.A.E.*, A **40** 198], the author states that *Hylemyia echinata* (Séguy), which has not previously been recorded as a pest, has for some years caused injury to spinach grown for processing and freezing in eastern and south-eastern England. All stages of this Anthomyiid are described, and characters are given distinguishing the eggs, larvae and adults from those of other species with which they might be confused. The eggs are laid singly on the upper surfaces of the leaves among the leaflets of the terminal and axillary buds in May. The larvae penetrate the epidermis and tunnel through the mesophyll until they reach the hollow mid-ribs, petioles or stems, on the inner surfaces of which they feed. As a result, the terminal shoots of the plants become blackened and distorted, and the petioles and mid-ribs split and become discoloured ; some larvae may still be present in the crop at harvest in early June. The puparia are usually found in the soil, but sometimes occur at the feeding sites. Observations on spinach sown on various dates show that there are three or four generations a year. In 1950 and 1951, larvae were first found in May and were present in the plants until late September. Adults emerged in late June and early July, and also in August and September in the laboratory.

Control is difficult on spinach grown for processing, since the crop is exposed to attack almost throughout its growing period and insecticidal sprays or dusts are liable to taint the foliage or leave toxic residues on it. There is some evidence that infestation is heaviest in early seasons, and in such circumstances harvesting the crop before it is fully grown might be desirable, to limit the attack.

H. echinata was also found on spinach from south-western England and has been recorded from France and Germany.

TAMS (W. H. T.) & BOWDEN (J.). **A Revision of the African Species of *Sesamia* Guenée and related Genera (Agrotidae—Lepidoptera).**—*Bull. ent. Res.* **43** pt. 4 pp. 645–678, 7 pls., 28 refs. London, 1953.

This revision was undertaken primarily to clear up longstanding confusion in the nomenclature of some stem-borers of the genus *Sesamia* that are injurious to graminaceous crops in Africa. It deals with six genera and 29 species, of which three genera and eight species are new, but the injurious species belong to only two of the genera, *Sesamia* and *Busseola*. The new genus *Speia* is erected for *Phalaena vuteria* Stoll, which occurs in South Africa and for which no food-plant is recorded, and it is shown that injurious species of *Sesamia* that have been recorded as *S. vuteria* have been misidentified as this species. They include *S. nonagrioides* (Lef.), the type of the genus, which is a pest of maize, its only known food-plant, in Spain [*R.A.E.*, A **19** 276], Portugal [**17** 116] and southern France [**12** 95, 228 ; **20** 109], and also occurs in Italy, Madeira, Azores and the Canary Islands ; *S. calamistis* Hmps., which is a major pest of sugar-cane in Mauritius [**5** 440 ; **9** 559 ; **20** 397 ; **22** 259], attacks rice and maize in Tanganyika [**15** 325], is also recorded from South Africa, Northern Rhodesia, Nyasaland, Uganda, Kenya, Zanzibar, Madagascar, Réunion, Angola, the Cameroons, Nigeria, the Gold Coast, the Ivory Coast, Senegal and the Gambia, and has been reported from the Belgian Congo [**18** 260] ; and *S. cretica*, Led., which is recorded from Italy, Corsica, Yugoslavia, Crete, Morocco, Egypt, the Sudan, Ethiopia, British Somaliland, Syria and Arabia, is a major pest of sorghum and to a less extent of maize wherever it occurs and has been reported from *Pennisetum typhoideum* in the Sudan [**25** 218]. *S. pecki* Tams [**26** 405] is a synonym of *S. cretica*.

S. botanephaga, sp. n., which is described from the Ivory Coast, the Gold Coast, Nigeria and the Sudan, has been confused with *S. calamistis* in West Africa. The ecological requirements of the two species are different, *botanephaga* being dominant in forest and fringing-forest areas where there is a minimum rainfall of about 50 ins. well distributed through the year, and *calamistis* in savannah areas with a well marked dry season. *S. botanephaga* is a serious pest of maize within its area of dominance. In the Gold Coast, it sometimes causes complete loss of crop, especially in late (September) plantings, and a record by Cotterell [**14** 9] almost certainly refers mainly to it. It has also been reared from sorghum, rice, sugar-cane and several grasses. *S. poephaga*, sp.n., is described from the Gold Coast, Tanganyika, Madagascar, Southern Rhodesia, Nyasaland, Kenya, Uganda, the southern Sudan, Nigeria and the Ivory Coast. In the Gold Coast, it occurs in the southern reaches of the savannah zone and in the transition zone of southern Togoland, and is frequent in maize, its only known food-plant, though of less importance than *Busseola fusca* (Fuller) and the Pyralid, *Eldana saccharina* Wlk. *S. penniseti*, sp.n., which is described from the Gold Coast, is known only from wet forest zones, and though occasionally bred from maize there, is of no economic importance.

Busseola is included in the revision because *B. fusca*, the only species considered, is involved in the wider problem of stem-borers in Africa.

Bradley (J. D.). **Some important Species of the Genus *Cryptophlebia* Walsingham, 1899, with Descriptions of three new Species (Lepidoptera : Olethreutidae).**—*Bull. ent. Res.* **43** pt. 4 pp. 679–689, 2 pls., 8 figs. London, 1953.

The author gives characters differentiating 16 of 18 species of Olethreutids that he includes in the genus *Cryptophlebia*, of which three are new and several others have not previously been referred to this genus, and gives records of their distribution and of their food-plants where known. The larvae are mostly borers in pods, fruits, seeds or stems, and some species of economic importance have been confused with one another. Swezey & Zimmerman have already shown that *C.* (*Argyroploce*) *carpophaga* Wlsm. is distinct from *C.* (*A.*) *illepida* (Btlr.) [*R.A.E.*, A **37** 82], but the author further considers that *C. carpophaga*, which is the type of the genus, is a synonym of *C.* (*Arotrophora*) *ombrodelta* (Lower). Two species that are pests in Mauritius [see next abstract] are *C.* (*Argyroploce*) *peltastica* (Meyr.), which is also injurious elsewhere [*cf.* **22** 141 ; **39** 143 ; **40** 42], and *C. williamsi*, sp. n., which attacks *Cajanus cajan*, *Canavalia ensiformis* and *Ceratonia siliqua* on that island and is also recorded from Madagascar. Neither Mauritius nor Africa is included in the distribution of *Cryptophlebia* (*Platypeplus*) *rhynchias* (Meyr.), and it is stated that its food-plants are unknown [which suggests that records of this species, as *Argyroploce rhynchias*, on *Canavalia ensiformis* in Mauritius (**9** 559 ; **25** 602) and *Sesbania* in Tanganyika (**23** 665) may be due to misidentification].

Williams (J. R.). **The Larvae and Pupae of some important Lepidoptera.**—*Bull. ent. Res.* **43** pt. 4 pp. 691–701, 5 figs., 8 refs. London, 1953.

Descriptions are given of the larvae of *Sesamia calamistis* Hmps. [*cf. R.A.E.*, A **41** 68), *S. inferens* (Wlk.), *Proceras sacchariphagus* Bojer, *P. indicus* Kapur [**39** 429], *Argyroploce schistaceana* (Sn.), *A. leucotreta* Meyr., *Cryptophlebia peltastica* (Meyr.) and *C. williamsi* Bradley [see preceding abstract], and of the pupae of all but *P. indicus*. *S. inferens* and *P. indicus* occur in India, and all the others in Mauritius, where *S. calamistis*, *P. sacchariphagus* and *A. schistaceana* are pests of sugar-cane, *A. leucotreta* bores in peach fruits and has also been reared from the seeds of castor [*Ricinus communis*],

C. peltastica infests the fruits of litchi (*Litchi chinensis*), the stems of *Poinciana regia* and the pods of *Ceratonia siliqua* and *Tamarindus indica* and has been recorded from *Canavalia ensiformis*, and *Cryptophlebia williamsi* has been reared from stems and pods of *Canavalia ensiformis*, stems of *Cajanus cajan* and pods of *Ceratonia siliqua*.

HOSKINS (W. M.), WITT (J. M.) & ERWIN (W. R.). **Bioassay of 1,2,3,4,5,6-Hexachlorocyclohexane (Lindane). Some Factors influencing the Contact of Chemical and Test Insect and Methods for standardizing the Process.**—*Analyt. Chem.* **24** no. 3 pp. 555–560, 2 graphs, 3 refs. Easton, Pa., 1952.

The following is based on the authors' summary. Quantitative determination of residual insecticides in foods is becoming increasingly important because of the extensive use of new and highly toxic organic compounds. Specific chemical methods are often unknown, and biological assay must be used. The authors describe procedures for the use of house-flies [*Musca domestica* L.] in bioassay for residues of γ BHC as lindane. Extracts of plant or animal tissues contain oily or waxy matter that may interfere with the test, but these can be removed wholly or partly by treatment with strong sulphuric acid or by passing the extract through a suitable column of solid adsorbent, and promising results were obtained by passing lindane residues through silica columns, when petroleum ether was employed as solvent and petroleum ether saturated with nitromethane or containing 5 per cent. benzene was added to remove the lindane. The residual lindane is collected on the interior surface of a shell vial in which the flies are later confined, and a small quantity of light spray oil is added. This spreads the toxicant in solution over the inner surface of the vial and so enables a large and consistent fraction of the total deposit to reach the test insects, but is not itself toxic. The uniformity of contact and large amount of insecticide picked up by the insects contribute to consistency of mortality, and the same procedure has been used successfully in preliminary tests with tetraethyl pyrophosphate, parathion and aldrin.

This method of bioassay enables very small residues of these insecticides to be determined in oils and other fatty products that cannot be handled by the customary methods, and it is useful not only for residue analysis, but also for determining the distribution of insecticides among the body tissues of insects. It is especially valuable for the study of the distribution and degradation of absorbed insecticides in plants and resistant insects.

BEARD (R. L.). **Effect of sub-lethal Doses of Toxicants on Susceptibility of Insects to Insecticides.**—*J. econ. Ent.* **45** no. 4 pp. 561–567, 1 fig., 17 refs. Menasha, Wis., 1952.

The susceptibility of insects that survive insecticidal treatment to the same or a different toxicant was tested on laboratory populations of larvae of *Galleria mellonella* (L.) and adults of *Oncopeltus fasciatus* (Dall.) by injection of about the median lethal dose of nicotine or sodium metarsenite dissolved in water or of pure p,p'DDT or 20 per cent. pyrethrum extract dissolved in olive oil and of various doses of the same or a different insecticide a week later. In almost all cases, *Oncopeltus* adults that received the first application were no more or less susceptible to the second than others that had not, but adults that survived the original DDT treatment were more susceptible than untreated ones to nicotine or DDT, and those surviving treatment with pyrethrum were possibly less susceptible to repeated treatment with it, though the difference barely reached significance. In most tests, treated *Galleria* larvae were more susceptible to the second treatment than untreated ones, and in no case were they less

susceptible. The survivors of groups of *Oncopeltus* that received doses of pyrethrum causing 8, 52, 79 and 93 per cent. mortality did not differ from untreated bugs in susceptibility to nicotine.

When given dosages of each insecticide were injected into *Oncopeltus* in a single dose or in two 1–4 days apart, the toxic effects of nicotine proved to be additive, arsenic was eliminated or detoxified, and pyrethrum and DDT appeared to have a sensitising effect when doses were administered on successive days, though some elimination appeared to occur after a longer interval, particularly in the case of pyrethrum. *Galleria* larvae showed similar results, except that nicotine also appeared to be eliminated or detoxified.

The essential similarity of the pattern of susceptibility of chemically selected insects to that of unselected insects suggested that the relative order of susceptibility of individuals varies, and this was found to be so when recovery time was used as the criterion for effectiveness of various materials causing stupefaction (carbon dioxide, nicotine and hydrocyanic acid gas). Such variation might be the cause of conflicting concepts in the problem of the development of resistance to insecticides and knowledge of it should help to clarify the conditions under which resistance might develop.

Casida (J. E.), Chapman (R. K.) & Allen (T. C.). **Relation of Absorption and Metabolism of Octamethylpyrophosphoramide by Pea Plants to available Phosphorus.**—*J. econ. Ent.* **45** no. 4 pp. 568–578, 3 graphs, 32 refs. Menasha, Wis., 1952.

The authors review literature indicating that the insecticidal activity of schradan (octamethyl pyrophosphoramide) applied systemically is low until metabolic activation of the chemical occurs in the plant [*cf. R.A.E.*, A **41** 22], and briefly record experiments showing that the amount of schradan required for 50 per cent. inhibition of rat-brain cholinesterase was at least 18 times as great when the schradan was added to homogenate from untreated pea plants as when it was applied to the plants and homogenates of these were subsequently tested. The origin and nature of the metabolite concerned are unknown.

The possibility that the amount of inorganic phosphorus available to plants may affect the absorption or metabolic breakdown of schradan was investigated in the main experiments described, in which assays were made by chemical determination of unmetabolised schradan in pea plants, by evaluation of the activated compound present from the ability of treated plant material to inhibit rat-brain cholinesterase, and by bioassay of the toxicity of treated plants to the pea Aphid [*Macrosiphum pisum* (Harris)]. The plants were grown in soil, sand containing various quantities of available phosphorus, and complete and phosphorus-deficient nutrient solutions, to which schradan was added at various rates.

The results showed that the absorption of schradan was reduced by available phosphorus, less inhibitor being formed and systemic toxicity decreasing as the amount of phosphorus in the solution increased. This did not occur when schradan was applied to the leaves or seed, and experiments with isolated roots showed that extracellular metabolism was not affected. Despite their low growth rates and smaller total root surface, plants grown in phosphorus-deficient solutions absorbed schradan at a greater rate than plants not deprived of phosphorus. As little as 5 parts phosphorus per million in the nutrient solution reduced the absorption of schradan, and the primary effect of phosphorus appeared to be on active absorption of schradan by the roots rather than on translocation or metabolism.

Metabolism may be affected, however. There was a close parallel in plants exposed to various concentrations of schradan between the amount of cholinesterase inhibitor formed and the amount of insecticide present, and the

amount of inhibitor formed from a given amount of schradan absorbed by the roots was affected by phosphorus level, a greater proportionate amount occurring in plants reared on solutions rich in phosphorus.

When applied at high concentrations to peas, schradan caused an initial decrease in the growth rate, followed by the appearance of chlorosis and necrosis. The injury was not affected by nitrogen or phosphorus deficiency, and technical schradan (42 per cent. pure) was more injurious than a purified sample (70 per cent. pure). Low concentrations sometimes accelerated growth. Plants grown in sand absorbed schradan more readily than those grown in soil [*cf.* **39** 428].

EWART (W. H.), GUNTHER (F. A.), BARKLEY (J. H.) & ELMER (H. S.). **Control of *Citrus* Thrips with Dieldrin.**—*J. econ. Ent.* **45** no. 4 pp. 578–593, 1 fig., 49 refs. Menasha, Wis., 1952.

The following is based on the authors' summary. The results are given of experiments carried out in southern California in 1949–51 on the effectiveness of dieldrin applied in sprays against *Scirtothrips citri* (Moult.) in preventing fruit scarring of navel oranges and grapefruit and protecting new vegetative growth on lemons.

It was found that 0·5 lb. dieldrin applied in 100 U.S. gals. spray per acre with a spray-duster prevented fruit scarring in heavily infested groves and in groves in which *S. citri* had apparently become resistant to DDT, and was as effective as 1 lb. per acre. There was no appreciable difference in effectiveness between emulsifiable concentrates and wettable powders. At 0·25 lb. per acre, dieldrin gave commercial control in groves having moderate but not heavy populations of the thrips.

Dieldrin at 0·5 lb. in 100 U.S. gals. per acre gave commercial protection of new growth on lemons for eight weeks or longer in groves in which the thrips population was light or moderate throughout the summer and for 4–6 weeks in groves where populations were heavy. In comparison, standard spray treatments with DDT or with nicotine, sabadilla or tartar emetic with sugar remained effective for 4–6 weeks in groves in which populations were light to moderate and for 2–4 weeks in those in which they were heavy.

The effectiveness of dieldrin was not increased by the addition of sugar or reduced by the addition of zinc oxide or zinc sulphate, as applied for mineral deficiency, but the addition of 20 lb. 15 per cent. wettable 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite or 40 per cent. wettable p-chlorophenyl phenyl sulphone powder or 10 lb. p-chlorophenyl p-chlorobenzenesulphonate per 100 U.S. gals. against mites apparently reduced it. The reason for this reduction is not known, but the presence of large amounts of solids in suspension may have masked the toxicity of dieldrin to the thrips; chemical incompatibility is not likely, since smaller amounts of the same materials and others, including di(p-chlorophenoxy)methane and EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate], did not have this effect in other experiments.

Residues of dieldrin in fruits were determined by means of a total-chlorine method that permitted the determination of very small quantities with a sensitivity of 0·1–0·2 part per million. This method, which is described in detail, involved the micro-combustion technique for the quantitative determination of organic chlorides and was adapted for residue studies of dieldrin in *Citrus* extractives. Inorganic chlorides were eliminated by washing the mixture of organic solvent and extract with water, and the final extractives were burnt at 1,000°C. in a stream of oxygen to carbon dioxide, water and the hydrogen halide, which was then determined potentiometrically.

Apparent dieldrin residues at harvest in October in navel oranges that had been sprayed with 0·5 lb. dieldrin per acre in May or August or 0·25 lb. in September amounted to 0·2–0·6 p.p.m. in the peel and 0–0·5 p.p.m. in the pulp, as compared with 0–0·3 and 0–0·4 in untreated fruits, and those in lemons that were treated with 0·5 lb. in June and August were 0·6–1·3 p.p.m. in the peel and 0·2–0·3 in the pulp six weeks after the second treatment, as compared with 0·6 and 0·4 p.p.m. in untreated fruits. In tests on the penetration and persistence of dieldrin in the peel of lemons, penetration of dieldrin from the surface to the inner portion of the peel was found to be more rapid for an emulsifiable concentrate than for a wettable powder. There was little, if any, accumulation of dieldrin in the wax layer. The loss of total dieldrin amounted to more than 75 per cent. within 31 days of application, with no appreciable difference between formulations in this respect.

Unlike DDT, dieldrin sprays applied for the control of *S. citri* had no harmful effect on *Rodolia cardinalis* (Muls.), the Coccinellid predacious on *Icerya purchasi* Mask., and there was no evidence that *Coccus hesperidum* L. increased abnormally as a result of possible elimination of its parasites by them.

GREEN (H. B.). **Biology and Control of the Imported Fire Ant in Mississippi.**—*J. econ. Ent.* **45** no. 4 pp. 593–597, 2 refs. Menasha, Wis., 1952.

Observations were made in 1949–50 on the habits and control of *Solenopsis saevissima* var. *richteri* Forel near Artesia, Mississippi [*cf. R.A.E.*, A **38** 34]. The infested area was about 15 miles square in 1949. Very few colonies were found in hardwood forests or in meadows in which Johnson grass [*Sorghum halepense*] predominated, and most occurred in pastures consisting largely of *Paspalum*, Bermuda grass [*Cynodon dactylon*] or clover ; rather heavy infestations were found on land under cotton, maize or sorghum crops. The mounds ranged up to 3 ft. in diameter and height, and were harmful to agricultural machinery, especially in hay fields. The ants sometimes leave their existing mounds and construct new ones, one colony observed doing so three times in 24 hours, and the numerous sexual forms produced and the inaccessibility of many of the mounds make complete control practically impossible. In field tests with dusts, 5 per cent. chlordane or 2·5 per cent. aldrin or dieldrin was more effective than 3 per cent. γ BHC, 20 per cent. toxaphene or 10 per cent. DDT or p,p'methoxy-DDT (methoxychlor) [*cf.* **38** 35, 371], but some ants usually survived in all treated areas. Chlordane, which is less toxic than aldrin or dieldrin to warm-blooded animals, was applied by punching holes in the mound surface at intervals of about 4 ins. and blowing the dust into the holes with a plunger duster ; by pushing the nozzle of a gun that delivered a high volume of dust-laden air under a moderate pressure into the centre of the mound, and pumping in first dust and then additional air to increase distribution ; by dusting the ground round the mound, digging out the mound and scattering the soil from it on the dusted surface and dusting this and the hole from which it was dug ; and by a method similar to the last, in which the mound was hoed down level with the ground instead of being dug out. In the last two methods, which appeared to be the best, the dust was applied through a double thickness of burlap sack, as application with a gun caused billowing and loss of dust. In the laboratory, dusts containing as little as 0·125 per cent. chlordane, aldrin or dieldrin gave complete mortality in 24 hours.

Area treatments with a dust and a spray giving 1·25 and 1·75 lb. chlordane per acre, respectively, with no land tillage, killed many ants, but only small colonies were eradicated ; large colonies were weakened but survived. Fumigation with methyl bromide, chloropicrin, acrilonitrile, carbon bisulphide and hydrocyanic acid gas was tested at different times of year under varying

conditions of temperature and soil moisture. The best results were obtained in hot weather, but all fumigant treatments were inferior to the 5 per cent. chlordane dust. Poison-baits were ineffective.

OWENS (H. B.) & DITMAN (L. P.). **Liquefied Gas-propelled Sprays for the Home Garden.**—*J. econ. Ent.* **45** no. 4 pp. 602–607, 1 ref. Menasha, Wis., 1952.

In further tests in 1950 and 1951 of aerosols for use on small crops of vegetables in Maryland [*cf. R.A.E.*, A **38** 503], the method of application was the same as that previously adopted and the amounts and kinds of the propellents and solvents were standardised. All the aerosol solutions contained 50 per cent. methyl chloride, and, except when otherwise stated, 42–49 per cent. methylene chloride in addition to the toxic ingredients. Treatments were applied at weekly intervals from the time plants were set out or showed above ground until just before the final harvest.

On snap beans, none of the aerosols tested in 1950 was satisfactory, and in 1951 only solutions containing 2·5 per cent. Dilan [a 1 : 2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], with or without 2 per cent. lindane and 3 per cent. DDT, were effective against adults of the Mexican bean beetle [*Epilachna varivestis* Muls.] ; those containing 2 per cent. chlordane, aldrin, dieldrin or γ BHC as lindane had some value against the larvae. On lima beans, the aerosols containing Dilan again gave the best control of the adults of *E. varivestis* and resulted in the highest yields, and lindane and Dilan were effective against the larvae. Light infestation by the black bean Aphid [*Aphis fabae* Scop.] was observed on 22nd August on two plots that had received Dilan without lindane and DDT. On broccoli, none of the aerosols tested in 1950 appeared satisfactory, though all gave some control of the cabbage looper [*Trichoplusia ni* (Hb.)], but on cabbage, which was substituted for broccoli in 1951, all caused increased yields, those containing lindane, dieldrin or Dilan being effective against flea-beetles and Lepidopterous larvae and those containing lindane or dieldrin against the cabbage Aphid [*Brevicoryne brassicae* (L.)].

On cantaloupe melon, the results were not statistically significant and insect records were not made, but the aerosols containing aldrin, dieldrin or lindane used in 1951 and one containing 1 per cent. lindane and 1·5 per cent. cubé resins (33 per cent. rotenone), with either methylene chloride or acetone, tested in 1950, all increased the yield. On cucumber in 1951, the formulations containing dieldrin and lindane and that in which Dilan, lindane and DDT were combined all caused significant increases in yield. Dilan appeared to cause cumulative injury to cantaloupe and resulted in the development of severe infestation by the melon Aphid [*Aphis gossypii* Glov.] on both cantaloupe and cucumber. Yield of tomatos was little affected by any of the aerosols, but in 1951, one containing 2 per cent. lindane gave the best control of fruitworms [*Heliothis armigera* (Hb.)], hornworms [*Protoparce quinquemaculata* (Haw.)] and the potato Aphid [*Macrosiphum solanifolii* (Ashm.)], and all the aerosols greatly reduced populations of the first two.

On potato in 1950, an aerosol containing 1 per cent. pyrethrum extract (20 per cent. pyrethrins), 1·5 per cent. cubé resin (33 per cent. rotenone) and 3 per cent. DDT significantly increased yield ; all formulae significantly reduced the flea-beetle [*Epitrix cucumeris* (Harr.)], none affected larvae of the European corn borer [*Pyrausta nubilalis* (Hb.)] and only those containing 1·5 per cent. cubé resin reduced the leafhopper [*Empoasca fabae* (Harr.)]. In 1951, the combination of Dilan, lindane and DDT gave the greatest increase in yield, though differences were not significant. Dilan gave excellent control of *Empoasca*, but did not increase the yield when used without DDT.

Aerosols containing lindane affected the flavour of early but not late potatoes. They slightly altered the flavour of cooked snap beans, but not that of cabbage, cucumbers, cantaloupes, tomatos, lima beans or broccoli. Lindane was generally the most effective of the insecticides tested and did not cause any retardation of growth, whereas chlordane and aldrin seemed to reduce the vigour and yield of some of the crops.

Smith (E. H.) & Harris (R. W.). **Influence of Tree Vigor and Winter Injury on the Lesser Peach Tree Borer.**—*J. econ. Ent.* **45** no. 4 pp. 607–610, 4 refs. Menasha, Wis., 1952.

Examination of peach trees in New York that had received different cultural treatments for three years and differed greatly in vigour, showed that there was a direct correlation between the degree of tree vigour and the number of larvae of *Aegeria* (*Synanthedon*) *pictipes* G. & R. per tree, but not between tree vigour and the rate of development of the larvae or their size when mature. It was found that the moths selected wounds on the bark surface for oviposition and were particularly attracted by those exuding gum, and that survival was higher when the newly-hatched larvae had ready access to active wounds. Wounds were caused largely by winter injury to crotches and large scaffold branches, and such injury was slightly greater and much more gum was exuded on trees of high vigour. There was no evidence that the larvae initiated injury.

Smith (E. H.). **Control of Peach Tree Borer and Lesser Peach Tree Borer.**—*J. econ. Ent.* **45** no. 4 pp. 611–615, 3 figs., 4 refs. Menasha, Wis., 1952.

In further investigations in 1951 on the control of *Aegeria* (*Sanninoidea*) *exitiosa* Say and *A.* (*Synanthedon*) *pictipes* G. & R. on peach in New York [*cf. R.A.E.*, A **40** 77], the last of the three spray applications previously used against the former was omitted, additional materials were tested, and special attention was given to ovicidal action.

In 1–3 spray applications against *A. pictipes* in June–August, 15 per cent. wettable parathion at 2 lb. per 100 U.S. gals. was much more effective than 25 per cent. wettable EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate] at 1·25 lb. All applications showed ovicidal action, but the most effective were those applied before appreciable hatch had occurred ; a single application of parathion on 7th June, when only 4 per cent. of the moths had emerged, gave 46 per cent. kill of all eggs laid during the season, as compared with no treatment, suggesting an extended period of ovicidal effectiveness. Parathion showed a high degree of correlation between control of eggs and ultimate control based on larval counts, whereas EPN was less effective as an ovicide but gave only slightly less final control than parathion, indicating that it is an effective larvicide.

Against *A. exitiosa*, the sprays of parathion and EPN and one of 1·25 lb. 25 per cent. wettable malathon per 100 U.S. gals. were applied on 17th July, 10th August or both dates. The results were in general agreement with those against *A. pictipes*, but single applications were more effective. All materials gave commercial control when applied twice, and all showed ovicidal effect, but parathion was the best, giving 93 per cent. mortality when applied on 17th July, before many eggs had been laid ; this suggests that the residue remained effective for almost the entire period of hatching. The correlation between kill of eggs and control of larvae was fairly close for the first application, especially in the case of parathion, and the second application was much the less effective.

There was evidently no essential difference in the reactions of the two species to parathion and EPN. The marked ovicidal action of the early sprays appeared

to be due partly to the effect of residues on eggs deposited some days after treatment. Differences in life-history and habits, chiefly in period of moth emergence and oviposition habits, that may account for differences in ovicidal effectiveness are discussed. It is concluded that commercial control of both species can be obtained with three applications of parathion or EPN, finishing in early August. The integration of these in the general control programme required on peach in western New York is discussed.

Gyrisco (G. G.), Hopkins (L.), Muka (A. A.) & Marshall (D. S.). **Concentration of several Insecticides for Control of Meadow Spittlebug on Red Clover.**—*J. econ. Ent.* **45** no. 4 pp. 615–619, 5 refs. Menasha, Wis., 1952.

Attempts were made in New York in 1950–51 to find the lowest rates at which various organic insecticides are effective in the field against nymphs of *Philaenus leucophthalmus* (L.) on leguminous forage crops [*cf. R.A.E.*, A **40** 230 etc.]. Aldrin, dieldrin, heptachlor, γ BHC as lindane, and Dilan [a mixture of 1,1-bis(p-chlorophenyl)-2-nitrobutane and 1,1-bis(p-chlorophenyl)-2-nitropropane (2 : 1)] were applied at 0·25–1·25 lb. toxicant per acre in talc to clover in the first and second crop year in May and June, respectively, and at 0·05–0·15 lb. toxicant per acre in emulsion sprays to clover in the first crop year on 17th or 24th May. There appeared to be no differences in infestation or in the resistance of the nymphs to treatment in the two cutting years. In the dusts, lindane and dieldrin were the most effective materials tested and gave fair to good control at all rates of application ; that recommended is 0·5 lb. per acre. Heptachlor gave fair control at 1·25 lb. per acre, but was not wholly satisfactory, and aldrin and Dilan were unsatisfactory at all rates. In the sprays, only BHC gave good control at all rates. Dieldrin gave fair to good control at 0·1–0·15 lb. per acre, but aldrin, heptachlor and Dilan were unsatisfactory and should be used at higher rates than those tested.

Weaver (C. R.) & Hibbs (J. W.). **Effect of Spittlebug Infestation on nutritive Value of Alfalfa and Red Clover.**—*J. econ. Ent.* **45** no. 4 pp. 626–628, 5 refs. Menasha, Wis., 1952.

The following is substantially the authors' summary. In tests in Ohio in 1949–51, control of the meadow spittlebug [*Philaenus leucophthalmus* (L.)] on red clover and lucerne by means of insecticides resulted in increases of 0·5–1 ton per acre in the yield of mixed hay and in a reduction in the percentage of dry matter in both clover and lucerne. Differences in protein and carotenoid content were not important enough to indicate that the spittlebug significantly reduces the nutritive value of individual plants. However, considerable increase in the nutritive value of a mixed hay crop on which it was controlled might result from an increase in the ratio of leguminous plants to grasses. Weather conditions and the presence of other insects affect the amount of damage caused by *P. leucophthalmus*, good growing conditions and abundant rainfall in early spring reducing the effect of infestation on the yield and nutritive value of the crop.

Hopkins (L.), Gyrisco (G. G.) & Norton (L. B.). **Effects of Sun, Wind and Rain on DDT Dust Residues on Forage Crops.**—*J. econ. Ent.* **45** no. 4 pp. 629–633, 1 graph, 20 refs. Menasha, Wis., 1952.

The following is based on the authors' summary. The weathering action on DDT dust residues of the sun, wind and rain, separately and in combination, was studied during two summers in New York by enclosing heavily dusted clover in specially constructed cages. It was found that either wind or rain

caused a rapid loss of deposit soon after application, but both were much less effective during the succeeding weeks, and the combined effect of wind and rain was less than might be inferred from their separate effects, presumably because both tend to remove mechanically the same less strongly adherent material. Sunlight caused a slower initial loss of deposit than either rain or wind, but its effect was continuous, and sunlight in combination with either wind or rain was more effective than was suggested by its separate action, because it affects the most adherent residue that is not reduced by the other factors.

Wilcox (J.) & Howland (A. F.). **Control of a Dipterous Leaf Miner on Tomatoes in California.**—*J. econ. Ent.* **45** no. 4 pp. 634–639, 7 refs. Menasha, Wis., 1952.

The following is largely based on the authors' summary. The results are given of experiments in southern California in 1948–51 on the control of a tomato leaf-miner here referred to as *Liriomyza* sp. [*cf. R.A.E.*, A **39** 240]. In 1948, toxaphene, BHC and chlordane were more effective than DDT in dusts and sprays, and in 1949, large-scale tests showed that dusts containing toxaphene alone or chlordane, toxaphene or aldrin with DDT were superior to DDT alone. Dusts of 10 per cent. toxaphene or 2 per cent. parathion were also tested, but were not considered promising for use on tomato, as they gave poor control of the tomato fruitworm [*Heliothis armigera* (Hb.)].

In 1950, when treatments were usually applied three times at fortnightly intervals, sprays of 6 lb. 25 per cent. dieldrin or 2 lb. 27 per cent. EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate] per 40 U.S. gals. gave good control, 7·5 lb. 40 per cent. chlordane per 40 U.S. gals. fair control, and 7·5 lb. 40 per cent. toxaphene and 6 lb. 50 per cent. DDT with 4 lb. schradan poor control. The addition of 10 lb. sugar to toxaphene, chlordane and dieldrin did not increase their effectiveness. All sprays were applied at 30–40 U.S. gals. per acre. When dusts were applied at 30 lb. per acre, 5 per cent. aldrin gave good control, 2·5 per cent. dieldrin fair control, 2 per cent. EPN or 20 per cent. toxaphene poor control, and 10 per cent. Compound 1189 (an oxygenated dimer of hexachlorocyclopentadiene) or p,p'fluoro-DDT (DFDT), 5 per cent. CS-708 [a 1 : 2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] or 10 per cent. toxaphene with 5 per cent. DDT little or none. In another test, malathon at 5 per cent. gave poor results, and 1–2 per cent. parathion with 5 per cent. DDT was largely ineffective, though it gave high control when applied at 15 lb. per acre once a week instead of 30 lb. once a fortnight.

In 1951, dusts containing 5 per cent. DDT with 2 per cent. parathion or EPN and one of 5 per cent. aldrin gave good control and were rather better than 2·5 per cent. dieldrin when applied five times at weekly intervals at 15 lb. per acre or three times at fortnightly intervals at 30 lb. per acre. DDT with parathion or EPN gave better results at the shorter interval and aldrin and dieldrin at the longer one. When applied at 30 lb. per acre three times at intervals of a fortnight, 5 per cent. heptachlor was considerably more effective than 1 per cent. Compound 711 or Compound 269 [stereoisomers of aldrin and dieldrin, recently named isodrin and endrin, respectively], and significantly better than 20 per cent. toxaphene, 2 per cent. Metacide [6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related organic phosphates], 10 per cent. Compound 1189 or DDT or 5 per cent. malathon or ethyl-DDD(Q-137)[1, 1-dichloro-2,2-bis(p-ethylphenyl)ethane]. When applied four times at intervals of 10 days in concentrated sprays at 5 U.S. gals. per acre, 3 lb. Metacide or 8 lb. DDT with 1·6 lb. parathion per acre gave excellent control, 1 lb. of the stereoisomers of aldrin and dieldrin good control, 4 lb. heptachlor or aldrin or

2 lb. dieldrin fair control, and 16 lb. toxaphene, 8 lb. Compound 1189, 4 lb. malathon or Q-137 and 8 lb. DDT poor control.

Dowdy (A. C.) & Sleesman (J. P.). **Systemic Poisons on Vegetable Crops.**—*J. econ. Ent.* **45** no. 4 pp. 640–643, 2 graphs, 6 refs. Menasha, Wis., 1952.

In tests with emulsion sprays in Ohio in 1951, two systemic materials were compared with DDT, parathion and malathon for the control of insects or mites on vegetable crops. The systemic materials were Systox (a concentrate containing 32·1 per cent. trialkyl thiophosphate [O-(2-(ethylmercapto)ethyl) O, O-diethyl thiophosphate]) and a concentrate containing 45 per cent. schradan.

On young turnip, Systox at 0·5 and 1 pint and the schradan concentrate at 0·5 and 4 pints per 100 gals. were applied on 20th July and 1st August or on 20th July only against *Rhopalosiphum pseudobrassicae* (Davis), and the results indicated that one application of schradan at the higher concentration was almost equal to two of the dilute spray ; that one application of the concentrated Systox spray was only slightly better than one of the dilute, and two of the dilute superior to one of the concentrated spray ; and that one application of the dilute Systox spray gave better results than one of a similar concentration of the schradan concentrate, whereas two of schradan at this concentration were better than two of Systox. It appeared that a small amount of Systox gave good control of the Aphid for about two weeks and that the schradan concentrate must be used at higher concentrations than Systox to be comparable in effect, but that its toxicity at similar concentrations is more persistent.

On mature egg-plant [*Solanum melongena*], one application of 0·25–1·5 pints Systox or 1 pint 25 per cent. parathion or 50 per cent. malathon per 100 gals. gave excellent control of *Tetranychus bimaculatus* Harvey, *Myzus persicae* (Sulz.) and *Macrosiphum* (*Illinoia*) *solanifolii* (Ashm.) in five days, whereas 1–1·5 pints schradan concentrate appeared slightly less effective. Similar results were observed on peppers [*Capsicum*] heavily infested by *Myzus persicae*. Young vigorously growing egg-plants lost toxicity rapidly, but those sprayed three times at 10-day intervals with 1 pint Systox or 4 pints schradan concentrate per 100 gals. showed 80–90 per cent. control of Aphids 24 days after the last application and 40–60 per cent. control of *T. bimaculatus* two months after it. When applied late in the season to egg-plants bearing established populations of Aphids and *T. bimaculatus*, Systox showed more persistent action than schradan, and when applied six times at 10-day intervals, the two concentrates at 1·5 pints per 100 gals. gave 95 and 33 per cent. control of the mite, respectively, 52 days after the last application.

On nearly mature potato, one application of Systox at 0·25–2 pints or a DDT spray controlled nymphs of *Empoasca fabae* (Harr.), whereas the schradan concentrate at 2–6 pints did not. Analyses of various vegetable samples for residues of the systemic materials gave conflicting results, and no general comparison could be made between them, but potato tubers from plots sprayed with Systox contained not more than 0·1 part per million of the compound, regardless of concentration and number of applications.

Newton (J. H.) & List (G. M.). **Woolly Apple Aphid in Codling Moth and Mite Control Spray Plots.**—*J. econ. Ent.* **45** no. 4 pp. 643–645. Menasha, Wis., 1952.

In view of the increases in *Eriosoma lanigerum* (Hsm.) that have frequently followed the application of DDT against the codling moth [*Cydia pomonella* (L.)] on apple, presumably owing to elimination of its parasite, *Aphelinus mali*

(Hald.), the results are given of observations in Colorado in 1949–50 on populations of the Aphid on trees sprayed primarily against *Cydia* and mites. All spray quantities are given per 100 U.S. gals.

In 1949, infestation was low after four applications of 25 per cent. parathion, alone at 1·5 lb. or at 1 lb. with 2 lb. 50 per cent. p,p'methoxy-DDT (methoxychlor) or 1 lb. 50 per cent. DDT and after four of 1·5 lb. 50 per cent. DDT with wettable micronised sulphur at 8 lb. in the first three and 4 lb. in the fourth, rather higher after four of 1·5 lb. 50 per cent. DDT with 1 lb. dinitrocaprylphenylcrotonate in all four or with a preparation containing 20 per cent. dinex (dicyclohexylamine) at 1·5 lb. in the first and 0·75 lb. in the others, and high after four of 3 lb. p,p'methoxy-DDT with dinex (dicyclohexylamine) at the same two concentrations.

In 1950, when five applications of 1·5 lb. 50 per cent. wettable DDT were made against *C. pomonella*, populations of the Aphid were lower after the addition of 0·75 lb. 25 per cent. parathion to all but the third or of 1 lb. 88-R[2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], 8 lb. wettable sulphur or 8 lb. fused bentonite sulphur to the first two and 0·75 lb. 25 per cent. parathion, 6 lb. wettable sulphur or 6 lb. fused bentonite sulphur, respectively, to the last two than they were after the addition of dinex (dicyclohexylamine), EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate], p-chlorophenyl p-chlorobenzenesulphonate, toxaphene, or dinitrocaprylphenylcrotonate in various applications. Wettable sulphur was effective when used only in the last two applications, but less so than when used in four. No treatment caused economic damage to the plants, and parathion and the two forms of sulphur did not affect the control of *C. pomonella* by DDT. The use of wettable sulphur with DDT proved effective against the Aphid in general use in 1950 and 1951.

Weinman (C. J.). **Effect of early Season Sprays against Plum Curculio on Peaches.**—*J. econ. Ent.* **45** no. 4 pp. 646–651, 6 refs. Menasha, Wis., 1952.

The effect of early sprays against the first generation of the plum curculio [*Conotrachelus nenuphar* (Hbst.)] on peach was tested in Illinois in 1950–51. To determine the effect of dieldrin on insects causing cat-facing, half the trees were sprayed in 1950 with 8 oz. actual dieldrin per 100 U.S. gals. spray at the time of 50 per cent. bloom and with sulphur at full bloom and half with 1 lb. actual DDT and sulphur on both dates, all trees receiving the same treatment for the rest of the season ; 2·7 and 8·8 per cent., respectively, of the total fruit crops were cat-faced, with 43·6 and 76 total injuries per 100 fruits by the curculio at the end of the first-brood period and 48·1 and 60·2 superficial injuries and 53·1 and 78·3 entries per 100 fruits at harvest.

In 1951, a standard schedule of DDT at full bloom (against cat-facing insects other than *C. nenuphar*) followed by chlordane or parathion at the petal-fall or shuck-split stages was compared with schedules in which dieldrin, chlordane or parathion, all of which are effective against *C. nenuphar*, were used at the full-bloom and petal-fall or shuck-split stages. The two series of plots received the same treatment for the rest of the season. Curculio control, as estimated by jarring and the infestation of dropped and picked fruits, was significantly better, the proportion of cat-faced fruits significantly lower and the proportion of the total crop remaining on the tree at harvest significantly higher in moderate or heavily infested plots receiving dieldrin, chlordane or parathion at full bloom than in those sprayed with DDT. Dieldrin applied at 4 oz. per 100 U.S. gals. was superior in the early-season sprays to parathion at 0·3 lb. or chlordane at 1 lb. No residues of dieldrin could be detected at harvest on leaves or fruits from plots sprayed at the bloom and shuck-split stages and none after 22nd June on fruits sprayed four times with 4 oz. dieldrin per 100 U.S. gals. between

27th April and 14th May, and the known rate of loss of dieldrin and the growth of the fruits precludes the possibility of perceptible residues on fruits not receiving dieldrin after the first cover spray.

DAVIS (D. W.). **Influence of Population Density on** *Tetranychus multisetis*.—*J. econ. Ent.* **45** no. 4 pp. 652–654, 2 refs. Menasha, Wis., 1952.

The following is substantially the author's summary. In experiments in which *Tetranychus multisetis* McG. was reared on ripe fruits of banana squash, dense populations resulted in a lower egg production per female and a higher proportion of non-viable eggs than occurred in a sparse population. The reduced number of eggs per female was noted before and the increase in non-viable eggs after the maximum population was reached. There was also definite mortality among the young mites as a result of crowding. Concentration in small areas usually makes an arthropod more vulnerable to attack by predators, but it is believed that the webbing produced by these mites affords enough protection to offset this disadvantage.

STEWART (W. S.), RIEHL (L. A.) & ERICKSON (L. C.). **Effects on** *Citrus* **of 2,4-D used as an Amendment to Oil Sprays.**—*J. econ. Ent.* **45** no. 4 pp. 658–668, 2 graphs, 18 refs. Menasha, Wis., 1952.

The following is based on the authors' summary and conclusions. In 1946–49, 63 replicated field experiments were carried out in representative *Citrus*-growing districts of California to determine whether the addition of 2,4-D (2,4-dichlorophenoxyacetic acid) at 0·8–8 parts per million to oil sprays applied for the control of *Citrus* pests would mitigate the harmful effects of these on the trees [*cf. R.A.E.*, A **39** 165]. The trees were 7–50 years old or more and included Washington navel orange, Valencia orange, grapefruit and lemon. The sprays were prepared by the tank-mix method in 1946–47 and from commercial formulations in 1948, and in most experiments 2,4-D was added in the forms in which it is used in weed-killing sprays. The plots were sprayed once a year, some for two years and a few for three.

The results showed that the addition of 4–8 p.p.m. 2,4-D to sprays applied in late summer increased the yield of navel orange and grapefruit, reduced the drop of mature fruits of navel orange and lemon, was more effective in reducing the drop of sound navel oranges than of culls, and reduced the drop of immature fruits of navel orange. It also reduced leaf drop from navel orange, Valencia orange and lemon, induced a deformation and curling of any young leaves, which did not, however, lower fruit yield or quality, and increased the percentage of total soluble solids in the juice of grapefruit. Application at 8 p.p.m. in three successive years did not affect the yield of Valencia orange.

Commercial oil sprays applied to navel orange, Valencia orange, grapefruit or lemon in late summer caused no significant differences in yield, fruit size, fruit drop or leaf drop as compared with untreated trees, but tank-mixed sprays caused significant increases in leaf drop on Valencia orange and lemon and a significant reduction in the percentage of total soluble solids in the juice of navel oranges.

Applications of oil sprays containing 2,4-D at seasons other than late summer reduced fruit and leaf drop. Fruit yields were reduced as a result of spring applications of oil sprays, with or without 2,4-D, but this effect was not observed at other seasons. A spray of 2,4-D in water, applied a week or more before an oil spray, was ineffective in reducing fruit drop caused by the oil spray on trees bearing mature fruit. In one experiment on Mediterranean sweet orange, the addition of 8 p.p.m. 2,4-D to an oil spray reduced the drop of mature fruit six months later.

JEPPSON (L. R.), JESSER (M. J.) & COMPLIN (J. O.). **Tree Trunk Application as a possible Method of using Systemic Insecticides on** *Citrus*.—*J. econ. Ent.* **45** no. 4 pp. 669–671, 9 refs. Menasha, Wis., 1952.

Natural enemies give valuable control of pests of *Citrus* in California [*cf. R.A.E.*, A **39** 375, etc.], and when systemic insecticides are applied to the leaves and fruits, they appear to affect these enemies adversely. The possibility of applying them to the trunk was therefore tested in October and November 1951. Schradan and Systox (principally O-(2-(ethylmercapto)ethyl) O,O-diethyl thiophosphate), in 50 per cent. emulsion concentrates, were used to saturate cotton wool or flannel, which was then wrapped round the trunk and covered with pliofilm strips to reduce evaporation, painted on the trunk, or diluted and sprayed on the trunk and the bases of the primary branches. Applications of the Systox concentrate at 0·5–4 oz. per tree to small lemon trees by the first two methods, and of Systox at the same rates and the schradan concentrate at 1–6 oz. per tree to lemon trees 30 years old by all three methods and to Valencia orange by the second and third were compared with spray applications at the same rates to the whole tree. Schradan was less effective than Systox at equivalent doses against *Paratetranychus citri* (McG.), regardless of the method of application, and resulted in inadequate control when applied to the trunk. Systox, applied to the trunk, caused high mortality of *P. citri* on the leaves, fruits and buds after 10–14 days. Mortality of adult mites generally increased with increased dosage, but was no greater when Systox was applied to the whole tree than when it was applied by some of the trunk treatments. Systox was not so effective against *Aceria sheldoni* (Ewing) in the buds, but the trunk treatments were as effective as application to the whole tree.

The direct application of an insecticide to the trunks of *Citrus* trees does not require the use of heavy equipment, which is often undesirable in *Citrus* groves, and is well adapted for the treatment of local infestations.

DUFFIELD (P. C.). **Combination Insecticide-fungicide Seed Treatments for Corn.** —*J. econ. Ent.* **45** no. 4 pp. 672–674. Menasha, Wis., 1952.

In the investigations described, maize seed was treated with chlorinated-hydrocarbon insecticides at various rates and stored at different temperatures and moisture levels to determine the effect of the materials on germination and growth. Untreated seed and seed treated with 1·5 oz. 50 per cent. wettable p,p'methoxy-DDT (methoxychlor) or 75 per cent. wettable γ BHC as lindane or with 3 oz. 25 per cent. wettable aldrin per bushel and having 2, 10 and 14 per cent. moisture content was stored at 6, 20 and 30°C. [42·8, 68 and 86°F.] for 40 weeks. All seed stored at 14 per cent. moisture content and 86°F. was injured by mould development in 10 weeks except that treated with aldrin, which remained sound for 24 weeks. Methoxy-DDT did not reduce germination, and aldrin did not until the 40th week, but lindane caused definite injury by the 24th week. The green weight of seedlings from seed stored for 40 weeks after treatment with methoxy-DDT, aldrin and lindane and not affected by moulds was 96, 86 and 55 per cent. of that from untreated seed.

When the seed was treated with 0·56–2·25 oz. technical lindane or 0·375–1·5 oz. technical aldrin, methoxy-DDT or dieldrin per bushel, either 12 weeks before sowing or immediately before it, and half of each sample was treated with a fungicide (Arasan [tetramethylthiuram disulphide]) immediately before sowing, only lindane significantly reduced the stand from freshly treated seed, with or without the fungicide, but all decreased the stand from stored seed, and methoxy-DDT and aldrin without fungicide and dieldrin and lindane with fungicide caused occasional decreases in yield, whereas lindane without fungicide always decreased yield. Dieldrin caused some increases in yield when applied immediately before sowing, either with or without the fungicide.

These results and those of further greenhouse experiments showed that lindane caused more retardation of top growth in sand than in peat or loam but equal root retardation in all three, and caused no injury after storage for 11 weeks if it was removed with benzene or chloroform before sowing. Lindane injury was increased by retarding the rate of germination and by low seed moisture, low germination temperatures and weakening of the seed by mould development in storage. Insecticidal injury rendered the seed more susceptible to seed-rotting soil pathogens. In a petri dish, an emulsifiable concentrate of aldrin appeared to nullify the fungicidal effects of Arasan, whereas a wettable powder did not. It is concluded that only methoxy-DDT approached favourable results and that insecticides should be applied to the seed shortly before planting and combined with a fungicide.

Connin (R. V.) & Kuitert (L. C.). **Control of the American Grasshopper with Organic Insecticides in Florida.**—*J. econ. Ent.* **45** no. 4 pp. 684–687, 1 ref. Menasha, Wis., 1952.

The following is substantially the authors' summary. Numerous reports of damage to cultivated crops by *Schistocerca americana* (Drury) were received from the south-eastern United States in 1950, and insecticides were tested for its control in Florida in 1951 between 3rd May and 13th June, when first-generation nymphs were present. Hand equipment was used on small plots and power equipment on large plots and in the field. Materials that gave satisfactory control on the small plots and (in brackets) the amounts of active ingredient per acre were dusts of 2·5 per cent. aldrin (4·4, 9·6 and 10·4 oz.), 10 per cent. toxaphene (2·55 and 3·45 lb.), 5 per cent. chlordane (1·3 and 1·42 lb.) and 2 per cent. parathion (6·24 and 9·6 oz.) and emulsion sprays of dieldrin (1·5 oz.), aldrin (5 oz.) and heptachlor (4 oz.), all of which gave average mortalities of at least 91 per cent. in three days and at least 88 per cent. after five, as compared with no treatment. Dusts containing 1 per cent. parathion at 3·1 oz. active ingredient and 3 per cent. γ BHC as lindane at 12·5 oz. active ingredient per acre were less effective. Only emulsion concentrates were tested on the large plots, and dieldrin at 1·5 oz., aldrin at 2–4 oz., toxaphene at 1·5 lb., heptachlor at 2 oz. and chlordane at 1 lb. per acre gave average mortalities of at least 94 per cent. in three days and at least 93 per cent. in five. Lindane at 0·5 lb. per acre was less effective. The first three of these sprays also gave good results in a field test.

Fleschner (C. A.). **Host-plant Resistance as a Factor influencing Population Density of Citrus Red Mites on Orchard Trees.**—*J. econ. Ent.* **45** no. 4 pp. 687–695, 6 graphs, 7 refs. Menasha, Wis., 1952.

The following is substantially the author's summary of this account of investigations in southern California in 1949–51. The removal of natural enemies of *Paratetranychus citri* (McG.) by hand-picking from individual *Citrus* trees over extended periods showed that the degree of resistance of the trees to mite attack ranged from almost complete immunity to marked susceptibility. There were indications that deposits of field dust, of DDT and of spray materials applied to counteract zinc deficiency lower the resistance of *Citrus* trees owing to some physical properties of the materials, that DDT sprays produce some change within the leaves that lowers resistance some time after application, and that this change spreads from older to younger leaves.

Intraspecific variation in plant resistance was observed, and young leaves tended to be less resistant to attack than older ones. However, the action of natural enemies may practically eliminate a population of *P. citri*, even when the plant offers relatively little resistance to infestation.

Reid jr. (W. J.) & Bare (C. O.). **Seasonal Populations of Cabbage Caterpillars in the Charleston, S.C., Area.**—*J. econ. Ent.* **45** no. 4 pp. 695–699, 1 graph, 4 refs. Menasha, Wis., 1952.

The following is based on the authors' summary. A survey of the seasonal populations of Lepidopterous larvae on cabbage was carried out in representative commercial plantings, most of which received the usual control treatments, near Charleston, South Carolina, between the autumn of 1935 and the spring of 1939. The plants were examined weekly from the time of thinning or transplanting, and the results indicated the times at which additional control measures were needed and the species against which they should be directed.

Trichoplusia ni (Hb.), *Heliothis armigera* (Hb.), *Laphygma frugiperda* (S. & A.), several cutworms and *Hellula undalis* (F.) were the most abundant species on autumn-grown crops, and infestation was greatest between mid-September and mid-November. On spring-grown crops, *Plutella maculipennis* (Curt.), *T.ni* and *Pieris rapae* (L.) were the most numerous, in that order. The first was most abundant during the first week of May, and the others were numerous throughout that month. All species were found in limited numbers in midsummer on the few cabbage and collard plantings then present. *T. ni* and *P. maculipennis* occurred on commercial cabbage plantings throughout the winter, though numbers were greatly reduced after the weekly mean temperatures fell below about 50°F. and remained comparatively low until they were consistently above 60°F. ; this usually occurred after the last week in March.

Fahey (J. E.), Hamilton (D. W.) & Rings (R. W.). **Longevity of Parathion and related Insecticides in Spray Residues.**—*J. econ. Ent.* **45** no. 4 pp. 700–703, 3 graphs, 8 refs. Menasha, Wis., 1952.

In a test in 1949, a single apple tree was sprayed with 3 lb. 25 per cent. wettable parathion powder per 100 U.S. gals. on 6th June and the foliage was analysed for residues after 1, 2 and 10 hours and 1, 2 and 4 days, during which period no rain fell and the average daily temperatures were 61·2–83·4°F. Plotting percentage deposit retained against logarithm of time gave a curve approximating to a straight line, and it is concluded that during a period of uniform temperature and no rain, the loss of parathion from deposits is a function of the logarithm of the time elapsed. The loss was very rapid.

Comparison in 1950 of residues on the foliage of single apple trees that were sprayed with 3 lb. 15 per cent. wettable parathion, with 1 U.S. pint xylene containing 35 per cent. methyl-parathion and 3 per cent. Triton X-100, with 1 U.S. pint Metacide [6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related organic phosphates] or with 1·5 lb. 25 per cent. wettable EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate] per 100 U.S. gals. and examined immediately and 1–14 days after each application showed that parathion was lost more rapidly than EPN, and less rapidly than methyl-parathion or Metacide during the first four days, though there was no difference in retention after seven days.

Fruits from peach trees that had been sprayed with 2 lb. 15 per cent. parathion or 1 lb. 25 per cent. EPN per 100 U.S. gals. on 5th and 21st July and 10th August 1950 in northern Ohio and with 1·5 lb. 15 per cent. parathion or 1 lb. 25 per cent. EPN on 17th and 26th April, 8th, 16th and 25th May, 7th June and 14th July in southern Indiana were examined on the day of the last application and at intervals for 29–36 days after it. The results showed that both materials were lost much more rapidly in Indiana than in Ohio. Although the persistence of EPN was greater than that of parathion, the difference between the two widely separated orchards was greater than that between the insecticides.

Smith (F. F.), Edwards (F. I.), Giang (P.) & Fulton (R. A.). **Residues of Organic Phosphorus Compounds and DDT on Greenhouse Vegetables.**—*J. econ. Ent.* **45** no. 4 pp. 703–707, 13 refs. Menasha, Wis., 1952.

The following is based on the authors' summary. The results are given of investigations carried out in Maryland in 1948–51 to determine the effect on growing vegetables of chemicals applied in greenhouses for pest control. Aerosols were applied to tomato, cucumber and lettuce at the rate of 1 gm. parathion or 0·5 gm. sulfotepp [tetraethyl dithiopyrophosphate] per 1,000 cu. ft. space and to tomato at 0·5 gm. DDT per 1,000 cu. ft., and parathion was added to soil in which tomatos and cucumbers were grown at rates of 8–128 and 8–64 lb. per acre, respectively. Parathion residues were determined by colorimetric analysis, the dithiopyrophosphate by cholinesterase inhibition and DDT by total-chlorine analysis. Clusters of tomato fruits that were protected from direct exposure to parathion aerosols by cellophane bags, tied in place after pollination or when the fruits were small, contained less than 0·1 part per million of parathion after 4–8 applications once a fortnight, whereas unprotected fruits contained up to 2·36 p.p.m., and harvested tomatos and cucumbers from plants grown in soil containing parathion contained not more than 0·01 and 0·02 p.p.m. parathion, indicating that there was no translocation from the leaves or soil. Residues of parathion on tomato decreased after each application and no accumulated residue was evident after nine made once a fortnight, but when nine applications were made at intervals of 3–4 days, the accumulated residue was 10·02 p.p.m., or about four times the maximum from any single application. Maximum parathion residues were 2·51, 2·36, 2·28, 0·47, 0·51 and 0·14 p.p.m. 1, 3, 5, 7, 11 and 14 days after treatment on tomato fruits, 0·62 p.p.m. on cucumbers and 21·53 p.p.m., decreasing to 1·56 p.p.m. in 14 days, on tomato foliage. On lettuce, residues of 34–56 p.p.m. immediately after treatment in two experiments decreased to 0·7 p.p.m. in 17 days, and an original residue of 97·8 p.p.m. in a third decreased to 2 p.p.m. in 20 days.

Residues of the dithiopyrophosphate were generally somewhat lower than those of parathion on tomato fruit or foliage and on lettuce, but the residues of the two materials decreased at nearly the same rate, although the insecticidal action of the former was short. The results indicated that residues of parathion on cucumbers are low, and that those of parathion and the pyrophosphate on tomatos decline to below 1 p.p.m. within seven days. The excessive residues on lettuce and their persistence for about three weeks indicate that these materials could not be safely used on this plant in greenhouses except possibly in the early stages of growth.

Residues of DDT on tomato fruits were 0·5 p.p.m. immediately after one application and 1·06 p.p.m. after two.

Hastings (E.) & Pepper (J. H.). **Early Spray Applications to control Alfalfa Weevil.**—*J. econ. Ent.* **45** no. 4 pp. 707–711, 4 refs. Menasha, Wis., 1952.

In a test in Montana in 1951 on the effect on the control of the alfalfa weevil [*Hypera variabilis* (Hbst.)] of applying insecticides to lucerne at different stages of growth, dieldrin was applied at 4oz. per acre in 10 U.S. gals. emulsion spray before any new spring growth was evident (4th April) or 8 or 22 days later, when 1–2 or 3–5 ins. growth was showing in some of the fields. Complete protection was given by the earliest application, all applications gave adequate control of adults, and control of the larvae was satisfactory on lucerne that was sprayed before it was 3 ins. high, but not on that sprayed later. It therefore appears that there is a period of 2–3 weeks in early spring when complete control of the larvae can be obtained by spraying against the adults, and the treatment should be carried out as soon as it is possible to use equipment in the fields. Later

treatment affords partial control of the larvae, but does not prevent all damage to the first cutting. There was considerable retardation of the second growth in untreated fields, and it was evident that even the latest spray had been of considerable value.

Spraying plants with 2–3 oz. dieldrin in 10 U.S. gals. emulsion per acre on 7th April, when new growth was just beginning to show, caused a very marked reduction in larval populations, and there was no apparent retardation in the second growth such as occurred on untreated plots, though there was some injury by larvae to plants in the first cutting. When applied by aeroplane between 4th and 12th April to lucerne just showing new growth, 2–3 oz. dieldrin in 2 U.S. gals. diesel oil per acre gave excellent control of larvae, whereas 4 oz. dieldrin in 1–1·5 U.S. gals. oil per acre did not prove satisfactory in all cases. It appears that a total volume of less than 2 U.S. gals. per acre is inadequate to ensure complete coverage. No close relations were observed between treatment and adult populations. Greater reductions in both larvae and adults were given by aeroplane application than by treatment with ground equipment, though this may have been due to greater persistence of the residues from the oil solution. No dieldrin residues were found at harvest on lucerne treated ten weeks previously at 2, 3 or 8 oz. per acre in diesel oil.

Portman (R. F.) & Williams (A. H.). **Control of Mosquito Larvae and other Pests in Rice Fields by DDT.**—*J. econ. Ent.* **45** no. 4 pp. 712–716, 3 refs. Menasha, Wis., 1952.

Fairy or tadpole shrimps of the genus *Apus* were first reported to be of importance as pests of rice in California in 1946, and since that time have caused damage throughout the rice-growing area of the northern Sacramento Valley. They chew off the tender leaves, dislodge the soil around the seedlings, causing them to float to the surface, and make the water muddy by their digging, thus preventing enough sunlight from reaching the submerged seedlings to ensure healthy growth. It is often necessary to resow the field because of the damage they do. The eggs remain in the soil through the winter and hatch when conditions become favourable upon flooding, even though the fields have lain fallow for more than a year.

In recent years also, larvae of the giant scavenger water beetle, *Hydrous triangularis* (Say), have become pests of considerable importance in some of the rice-growing areas of California. They uproot the seedlings and also keep the sunlight from them by disturbing the soil. Like *Apus*, they are active during the first few weeks after flooding. The present method of controlling *Apus* is to apply about 10 lb. copper sulphate per acre by aeroplane when damage is noticed, but this is ineffective against the beetle larvae. With a view to finding a method that would control both and also be effective against larvae of *Aëdes dorsalis* (Mg.), which is a serious pest in the area, extensive field tests were made in the spring of 1950 with DDT applied before flooding, with the rice seed at sowing or when the pests were already present.

When the dry cultivated soil was sprayed with an emulsified xylene solution of DDT at 1–4 lb. DDT per acre or a wettable-powder suspension at 4 lb. per acre and flooded within nine days, the water remained lethal to caged fairy shrimps for at least two weeks, *Aëdes* and *Hydrous* larvae were effectively controlled, and the fields were not infested by other mosquito larvae for about a month. This method is applicable where dry rice seed is broadcast with ground equipment before the fields are flooded. After 3,910 acres of rice-fields had been treated with DDT at 1–4 lb. per acre by mixing a wettable powder with the damp rice seed applied from aircraft, no infestation by *Apus* occurred, though many of the fields had been heavily infested in previous years, no larvae of *Aëdes dorsalis* or other mosquitos appeared for about a month and the *Hydrous*

larvae were effectively controlled in the individual fields observed. In 1951, many rice growers applied wettable-powder DDT with their seed, and no damage by *Hydrous* larvae or *Apus* occurred in about 60,000 acres so treated, while trouble from *Aëdes dorsalis* was greatly reduced. This is an effective and economical method of control, where sowing is done from aircraft. Spraying of infested fields with DDT in emulsified xylene solution at 8–16 oz. DDT per acre killed *Apus*, *Hydrous* larvae and mosquito larvae in 20 hours. This method is also very effective against the adult beetles.

McEwen (F. L.) & Chapman (R. K.). **Imported Cabbageworm Resistance to Insecticides.**—*J. econ. Ent.* **45** no. 4 pp. 717–722, 16 refs. Menasha, Wis., 1952.

The following is substantially the authors' summary. During the summer of 1951, *Pieris rapae* (L.) was found to have acquired field resistance to DDT applied to cabbage for control of the larvae, in an area with a radius of 6–8 miles in Kenosha and Racine counties, south-eastern Wisconsin. DDT had been used in this area consistently for five years, and during this time 15 generations may have been exposed to it.

In tests of various insecticides in sprays, larvae from the area concerned were markedly resistant to DDT and also to ethyl-DDD (1,1-dichloro-2,2-bis(p-ethylphenyl)ethane) and showed some resistance to DDD (TDE) and p,p'methoxy-DDT (methoxychlor). Control by parathion was somewhat erratic within the resistant area, but parathion, malathon and Metacide [6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related organic phosphates] generally gave satisfactory results. CS–708 [a 1 : 2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] gave excellent control of both the resistant and susceptible larvae, and 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-endo-endo-dimethanonaphthalene [the isomer of dieldrin recently named endrin], in less extensive tests, gave highly satisfactory control of the resistant larvae. Piperonyl butoxide did not show synergism with DDT against resistant larvae, but complicating factors rendered the results inconclusive.

Sinclair (W. B.) & Lindgren (D. L.). **Effect of Load in Fumatorium on Sorption of Fumigants.**—*J. econ. Ent.* **45** no. 4 pp. 726–731, 3 graphs, 10 refs. Menasha, Wis., 1952.

The following is substantially the authors' summary. The relation of load in the fumatorium to the amount of fumigant sorbed from the gas phase during a 6-hour exposure period was determined for methyl bromide, ethylene dibromide, ethylene chlorobromide and hydrocyanic acid gas. Time-concentration curves were determined for the various fumigants in empty airtight metal chambers with a capacity of 100 cu. ft. and in similar chambers containing loads of 9 and 19 boxes of oranges occupying 18 and 38 cu. ft., respectively, or 50 avocado shipping flats of excelsior, occupying 32 cu. ft.

The results showed the high sorptive capacity of oranges and excelsior for the various fumigants, even though the commodities never occupied more than 38 per cent. of the space in the fumatorium. Under these experimental conditions, ethylene dibromide and ethylene chlorobromide were sorbed to about the same extent on the exposed surface of the excelsior. The amount of a fumigant sorbed by a commodity during fumigation depends on the character of the material being fumigated and on the physical and chemical properties of the fumigant. The solubility of HCN in water in all proportions is highly correlated with its high sorption by the fruit and excelsior. The experiments with excelsior

indicate that when fruit is fumigated, it should be treated without packing materials and that dosages recommended for fruit only should not be used in fumigating samples that are packed or wrapped.

Wessel (R. D.) & Polivka (J. B.). **Soil pH in Relation to Japanese Beetle Populations.**—*J. econ. Ent.* **45** no. 4 pp. 733–735, 1 ref. Menasha, Wis., 1952.

The effect of soil pH on populations of *Popillia japonica* Newm., was investigated in Ohio in 1949-51 in an attempt to discover why infestation had increased in some areas and not in others. In grass plots in which the pH was adjusted to about 3·9, 4·3, 4·8, 5·3 and 6·8 to determine the effect of soil acidity on oviposition, significantly fewer eggs and first-instar larvae were found at the highest pH than at any others in 1949, and trends were similar in 1950. Counts made in October 1949 showed significantly fewer surviving larvae in the plots with the lowest and highest pH values (3·8 and 6·8), the former of which were practically devoid of vegetation, and similar counts in 1950 and 1951 showed most larvae in the plots with the lowest pH (4·1 and 4·2, respectively) and fewest in those with the highest pH (6·8 and 7·66, respectively).

The results indicate that maximum oviposition is closely associated with high acidity of the soil but that egg deposition is possible in alkaline soil. Survival of larvae appears to be greatest from pH 4·5 downwards, and larval development is probably possible at pH values ranging from an acidity at which plant growth is inhibited to a degree of alkalinity above pH 7·66. Under natural conditions, it was observed that large populations of larvae were associated with low soil pH and that the optimum range of larval distribution fell between pH 4 and pH 4·5. It is concluded that larvae of *P. japonica* have a broad tolerance of soil pH, but that rapid population increases may be favoured by acidity.

Beckham (C. M.) & Dupree (M.). **Attractants for the Green June Beetle with Notes on seasonal Occurrence.**—*J. econ. Ent.* **45** no. 4 pp. 736–737, 1 graph, 3 refs. Menasha, Wis., 1952.

Adults of *Cotinis nitida* (L.) are injurious to ripening fruits [*cf.* *R.A.E.*, A **28** 385], and the larvae damage pastures, lawns and golf greens. The Cetoniid appears to be increasing in Georgia, and the numbers of adults caught in bait pails hung in peach trees in four orchards were counted twice a week in May–November 1949, May–September 1950 and April–October 1951. The baits were mixtures of 2·4 lb. malt extract, 14 gm. terpinyl acetate, 8·5 gm. bentonite and 5·7 gm. sodium benzoate in 5 U.S. gals., or bentonite soaked in 1 U.S. pint water with 20 ml. anethole, added to 38 gm. sodium benzoate, 1 U.S. quart molasses and 5 U.S. gals. water, and both were diluted with water (1 : 3). Both sexes were attracted, and the ratio of males to females caught in July and August 1950 was about 3 : 2 [*cf.* **33** 348]. Beetles were collected as early as 15th May (1950) and as late as 23rd September (1951), but activity was greatest between 1st July and 20th August. Heavy rain that thoroughly wet the soil appeared to result in increased emergence. The first bait was much the more effective and when tested near pasture, caught 2,172 in one pail between 19th July and 24th August 1950. Limited observations on this bait and one of fermenting malt, sodium benzoate and water alone, in pails in fig trees and on the edge of pasture in 1949, indicated that the complete bait was the more effective, but comparison of the two baits in a peach orchard in 1951 showed that more beetles were collected by the second, and it is concluded that terpinyl acetate is not needed in the formula. The bait might be used to reduce infestation on ripe fruits and also as a supplementary measure to protect grassland.

Armitage (H. M.). **Effect of Naphthyl Acetic Acid on Cherry Fruiting.**—*J. econ. Ent.* **45** no. 4 p. 738. Menasha, Wis., 1952.

An attempt is in progress to eradicate an incipient infestation by *Rhagoletis cingulata* (Lw.) on domestic cherries in an isolated non-commercial area in northern California, and it was desired to prevent fruiting by any of the host cherry trees scattered throughout the area. It was thought that this might be accomplished by a post-bloom spray of naphthyl acetic acid, which has been successfully used as a thinner on apple and peach, but treatment failed on cherry even though the spray was used at a much increased concentration. It produced a completely hyponastic effect on the foliage, but did not affect the quantity or quality of the fruit. A second application after 30 days did not improve the result.

Graham (C.). **Control of Peach Insects with dilute and concentrated Sprays.**—*J. econ. Ent.* **45** no. 4 pp. 738–739, 1 ref. Menasha, Wis., 1952.

In an experiment in Maryland in 1951 to compare concentrated and dilute sprays for the control of the plum curculio [*Conotrachelus nenuphar* (Hbst.)], the oriental fruit moth [*Cydia molesta* (Busck)] and insects that cause cat-facing on peach, treatments were applied on 27th April, 12th, 17th and 28th May and 16th July with a machine adjusted to deliver about 4 U.S. gals. dilute or 1–2 U.S. gals. concentrated spray per tree ; 6 and 18 lb. sulphur per 100 U.S. gals. was added to dilute and concentrated sprays, respectively, and on 20th August all plots were given a fungicidal spray of 6 quarts lime-sulphur per 100 gals. Records of fruit injury on fallen and harvested fruits showed that concentrations of 1 or 3 U.S. quarts 18·5 per cent. dieldrin emulsion concentrate per 100 U.S. gals., with the addition of 2 or 6 lb. 50 per cent. DDT paste, respectively, in the first and third applications, 1 or 3 lb. 15 per cent. wettable parathion, 1 or 3 lb. 27 per cent. wettable EPN (O-ethyl O-p-nitrophenyl benzenethiophosphonate), 1 or 3 U.S. pints Metacide (6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related organic phosphates), and 2 lb. 25 per cent. wettable dieldrin with 2 lb. 50 per cent. DDT in the first and third applications all gave satisfactory insect control with little difference between materials or between dilute and concentrated sprays, whereas Systox (32·1 per cent. O-(2-(ethylmercapto)ethyl O,O-diethyl thiophosphate) at 1·5 pints per 100 gals. was ineffective whether applied to the trees or to the soil only and injured foliage and fruits.

Lowry (W. L.) & Calhoun (S. L.). **Control of Yellow-striped Armyworm on Cotton with Organic Insecticides.**—*J. econ. Ent.* **45** no. 4 p. 741, 1 ref. Menasha, Wis., 1952.

Prodenia ornithogalli Gn. is not normally injurious in the Mississippi Delta, but caused damage in the spring and summer of 1951, particularly to young cotton early in the season, and investigations on its control were begun in July. Young cotton plants were treated with emulsion sprays, applied with a hand-operated sprayer, and immediately covered with individual cages, into each of which ten larvae were released. The percentages dead or paralysed were 100 for EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate] at 0·1 lb. per acre after 90 hours and at 0·2 lb. after 22 hours, and 49 for aldrin at 0·17 lb., 42 for chlordane at 0·33 lb., 37 for Compound 269 (an isomer of dieldrin [recently named endrin]) at 0·07 lb., 3 for Compound 711 (an isomer of aldrin [recently named isodrin]) at 0·07 lb., 67 for DDT at 0·33 lb., 70 for dieldrin at 0·1 lb., 11 for heptachlor at 0·17 lb., 17 for γ BHC as lindane at 0·2 lb., 89 for DDD (TDE) at 0·33 lb., and 78 for toxaphene at 0·83 lb. per acre, all after 90 hours.

Except toxaphene, which was as effective at 0·33 lb., and Compound 269, which gave 67 per cent. dead or paralysed after 90 hours at 0·03 lb. per acre, all the chlorinated hydrocarbons were less toxic at lower concentrations.

DITMAN (L. P.), BURKHARDT (G.) & BLACK (D. T.). **Flat, hollow, and solid Cone Nozzles for Earworm Control.**—*J. econ. Ent.* **45** no. 4 pp. 742–743, 1 ref. Menasha, Wis., 1952.

Nozzles of several types were compared for the application of an emulsified solution of DDT to sweet maize for the control of the corn earworm [*Heliothis armigera* (Hb.)] and the European corn borer [*Pyrausta nubilalis* (Hb.)]. Flat nozzles with spray angles of 40°, solid cone nozzles (30°) and hollow cone nozzles (75°) were used on booms with four nozzles per row, and two solid cone nozzles (50°) per row were also tested. All methods of treatment gave some control of both species and increased the proportion of uninfested ears at harvest, with no significant differences between treatments, but none affected the total weight of ears at harvest. The four narrow solid cone nozzles per row applied the heaviest deposits of spray on the ear region of the plant, the hollow cone nozzles appeared to leave the lightest deposit and gave the least penetration, and the flat nozzles gave a coarse large-particle spray and the greatest penetration. With all types of nozzles directed horizontally or nearly so, the heaviest deposits of spray were in the lower parts of the spray patterns owing to the downward drift of the larger droplets.

STEINHAUS (E. A.) & HUGHES (K. M.). **A Granulosis of the Western Grape Leaf Skeletonizer.**—*J. econ. Ent.* **45** no. 4 pp. 744–745, 3 figs., 2 refs. Menasha, Wis., 1952.

Diseased larvae of *Harrisina brillians* B. & McD., observed among populations reared on grape leaves in the laboratory in Arizona and California in August and October 1950 and in May and July 1951, were found to contain a spore-forming bacterium, apparently *Bacillus cereus*. After July 1951, the numbers of diseased larvae in the cultures increased rapidly, and microscopic examination showed that they were infected by a granulosis virus. The measurements of the granules, obtained from electron micrographs, are given, and the symptoms produced in the larvae are described. In tests, the virus did not infect larvae of *Peridroma saucia* Hb. (*margaritosa* (Haw.)), *Junonia coenia* Hb., *Estigmene acraea* (Dru.) or *Pieris rapae* (L.), the hosts of most of the granuloses already described.

WENE (G. P.) & WHITE (A. N.). **Control of the Texas Harvester Ant.**—*J. econ. Ent.* **45** no. 4 pp. 745–746, 2 refs. Menasha, Wis., 1952.

Pogonomyrmex barbatus var. *molefaciens* (Buckley) is of importance in the Lower Rio Grande Valley of Texas because of its habits of destroying seeds and all vegetation within about 3–6 ft. of its nest entrances and stinging man. Up to 30 colonies per acre have been seen in cultivated fields and *Citrus* orchards. The nests usually have only one entrance each, and in experiments on control, emulsion concentrates were diluted in water and poured into nests showing at least 25 ants within one foot of the entrance, at 1 U.S. gal. per nest. Ant activity was observed for eight weeks. Aldrin, heptachlor and dieldrin at 0·2 per cent. gave complete control in all the colonies treated, whereas 0·2 per cent. chlordane gave 78 per cent. control after two weeks and 44 per cent. after eight [*cf. R.A.E.*, A **36** 94], and 2 per cent. Metacide (6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related

organic phosphates) gave 100 per cent. after two weeks and 80 per cent. after eight ; 0·2 per cent. toxaphene and 0·08 per cent. γBHC were ineffective. Chlordane was as effective at 0·1 as at 0·2 per cent., and aldrin at 0·05 as at 0·1 per cent. ; the latter gave 75 per cent. control after two weeks, but only 25 per cent. after eight. Numerous dead ants were found round the entrances one day and 2–4 weeks after treatment with 0·2 per cent. aldrin, dieldrin or heptachlor, indicating the importance of using a material that will kill ants that hatch after treatment.

Barnes (D. F.) & Simmons (P.). **Competition between Saw-toothed Grain Beetle and Indian-meal Moth.**—*J. econ. Ent.* **45** no. 4 pp. 750–751. Menasha, Wis., 1952.

Since attempts to establish mixed populations of *Oryzaephilus surinamensis* (L.) and *Plodia interpunctella* (Hb.) in stored raisins usually resulted in the decline of the latter, *Oryzaephilus* attaining dominance during the summer after harvest, and *Plodia* rarely becoming abundant at any time, competition between the two species was investigated. About 100 eggs of *Plodia* and 0, 25, 31 or 50 adults of *Oryzaephilus* were added to four dishes containing 40–50 seedless raisins on 26th November 1951, and 70 moth eggs and 0, 25, 50 or 100 beetle adults to four others on 15th January 1952. The numbers of moth eggs that hatched and (in brackets) the percentages of larvae that survived were 84 (43), 99 (42), 96 (50) and 100 (10) in the first series, in which the larval counts were made after 16–18 days, and 49 (45), 61 (38), 58 (16), and 66 (8) in the second, in which they were made after 36–41 days. The beetles were observed feeding on moth eggs, and they did not reproduce. The sharp contrast in larval survival between dishes containing 0–31 beetles and those containing 50 or 100 indicates that *Oryzaephilus* can suppress *P. interpunctella* when present in great enough numbers.

Chao (Yung-chang) & Peterson (A.). **A new Type of Aspirator.**—*J. econ. Ent.* **45** no. 4 p. 751, 1 fig., 2 refs. Menasha, Wis., 1952.

Moving test insects from a standard culture by means of an ordinary aspirator is time-consuming and may result in injury to some during the transfer from the aspirator to the container. The authors therefore describe a modification in a direct-suction or blower-suction (venturi type) aspirator that makes it possible to collect the insects directly into a container, thus reducing injury and saving time.

Dickason (E. A.). **A Case bearing Coleopteron,** *Diachus auratus* **(F.).**—*J. econ. Ent.* **45** no. 4 p. 751. Menasha, Wis., 1952.

The author reports that *Diachus auratus* (F.), the adults of which have recently damaged strawberries in Utah [*cf. R.A.E.*, A **38** 374] and avocados in California, have case-bearing larvae, examples of which were found on blossoms of red clover in Oregon. In laboratory rearing tests, eggs of this Cryptocephalid were laid in the flowers and on the under sides of the leaves of clover and were enclosed in heavily sculptured oval cases that caught on the pubescence of the plant parts. The larva hatched in 10–14 days by opening one end of the case, but remained attached to it and dragged it along, withdrawing into it when disturbed. It fed on the small florets without any apparent damage to the flowers, split its case and widened and lengthened it with débris after 6–8 days, and pupated within it after an average of about 30–34 days. The pupal stage lasted 20–21 days.

Frings (H.) & Peissner (L.). **Substitutes for Milkweed Seeds in the Rearing of Milkweed Bugs.**—*J. econ. Ent.* **45** no. 4 p. 752, 1 ref. Menasha, Wis., 1952.

Oncopeltus fasciatus (Dall.) is normally reared in the laboratory on seeds of milkweed [*Asclepias*], but these are difficult to obtain. In tests of substitutes in Pennsylvania, sunflower, squash and pumpkin seeds proved satisfactory, provided that the seed-coats were removed [*cf. R.A.E.*, A **39** 19.] In an attempt to find a food that would require less preparation, dog biscuit, milk powder, rolled oats and blanched raw groundnuts were tested. The first three were unsatisfactory, but the bugs were reared as readily on the last as on milkweed seeds. As the blanched groundnuts can be bought ready for use, are cheap and ensure as good growth and reproduction as milkweed seeds, they meet all the requirements for a substitute food.

Essig (E. O.). **A Change in the Nomenclature of Carrot and Celery Aphids.**—*J. econ. Ent.* **45** no. 4 p. 752. Menasha, Wis., 1952.

The author states that the Aphids described from California as *Aphis ferruginea-striata* Essig [*R.A.E.*, A **27** 590] have been found to comprise two species described previously [**11** 530], *Anuraphis* (*Sappaphis*) *foeniculus* Theo. on carrot and *A.* (*S.*) *apiifolia* Theo. on celery and poison hemlock [*Conium maculatum*].

Young (H. C.), App (B. A.), Gill (J. B.) & Hollingsworth (H. S.). **White-fringed Beetles and how to combat them.**—*Circ. U.S. Dep. Agric.* no. 850, 15 pp., 10 figs. Washington, D.C., 1950.

Introduced species of *Graphognathus* cause severe damage to many field and market-garden crops in the United States from the Gulf Coast to North Carolina, chiefly owing to feeding by the larvae on the roots. Only females have been found, and reproduction is parthenogenetic. The adults have been observed feeding on plants of more than 170 species, and the larvae on 240. Of the species and races of *Graphognathus* known to occur in the United States [*cf. R.A.E.*, A **37** 36–37], *G. peregrinus* (Buchanan), *G. leucoloma fecundus* Buchanan, *G. l. striatus* (Buchanan) and *G. l. imitator* Buchanan have been studied in their respective areas of distribution. The bionomics of all these are similar, and those of *G. l. fecundus* are described from investigations in Alabama, the other forms being referred to when they differ.

There is only one generation in the year. The adults emerge in May-October and do not move far if food-plants and shelter are available. They oviposit 5–15 days after emergence, usually close to the soil surface, and lay some 1,500 eggs each, generally in masses of 11–14, over a period of 30–60 days. They usually die within 90 days, but sometimes survive for 150. The adults of *G. peregrinus* are longer lived, but have a longer preoviposition period, and both this species and *G. l. imitator* produce fewer eggs than *G. l. fecundus* or *G. l. striatus*. Most of the eggs are laid between June and late autumn. Summer eggs hatch in 11–30 days, but those laid in late summer or autumn do not do so until the following spring if kept under dry conditions, as the larvae require moisture for hatching. Adults of *G. peregrinus* deposit a few eggs throughout mild winters and have oviposited as late as April in the Gulfport area. The larvae develop in the soil, and most of them overwinter, some that hatch in summer doing so twice, but some of the larvae that hatch in winter or early spring give rise to adults in the following summer. Pupae are most numerous in June and July. The pupal stage lasts 13 days in summer, and longer in cooler weather.

The larvae cause most damage in spring, but also attack vegetable crops in late summer or autumn. They destroy the tap root and bottom of the stem and sometimes burrow into tubers, bulbs and large seeds, but do little feeding on the small lateral roots Infestation is sporadic, and most of the feeding occurs within 5 ins. of the soil surface. Severe damage has been recorded on maize, cotton, groundnuts, potato, tobacco, strawberry and various market-garden crops, but pasture grasses and small-grain cereals withstand heavy infestation without apparent injury. As the larvae feed less during cold weather, plants grown during autumn and winter are less severely damaged than those grown in spring. The adults seldom cause serious injury, but sometimes defoliate the plants when numerous ; they prefer the foliage of broad-leaved species.

Populations of *Graphognathus* can be reduced by planting small grains in heavily infested land and by planting groundnuts, soy beans and other favoured food-plants on not more than a quarter of the cultivated area each year and on the same area only once every 3–4 years. Maize should not be intercropped with leguminous plants [*cf.* **33** 259], should be freed from broad-leaved weeds, and should be grown in heavily fertilised soil. Thorough disking at ten-day intervals in June and July kills many of the pupae. No insect parasites of *Graphognathus* are known in the United States. The soil-inhabiting stages are attacked by nematodes [*cf.* **34** 177, 343] and the fungus, *Metarrhizium anisopliae*, which are of little importance, and all stages are destroyed by predators.

Adults feeding on ornamental plants can be controlled by sprays of 10–12 lb. cryolite (at least 85 per cent. sodium fluoaluminate) or 1 lb. actual DDT, in a wettable powder, per 100 U.S. gals., applied when the foliage is dry, or by dusts of undiluted cryolite or 3–5 per cent. DDT at 12–15 lb. per acre when it is moist. The DDT sprays should be applied every 10–15 days, and the other treatments every 7–10 days. Food-crops should not be treated with these materials. The larvae can be controlled by adding 10 lb. technical DDT per acre to the soil after it has been ploughed or dug, in a spray or dust or mixed with sand, and working it into the top 3–4 ins. [*cf.* **40** 341.] For row crops, DDT should be applied in sand to the drills before or at planting time at rates of 2·5–5 lb. per acre. Treatment should be repeated annually for three or four years or until a total of 10–15 lb. DDT per acre has been applied.

BRIGHT (N. F. H.), CUTHILL (J. C.) & WOODBURY (N. H.). **The Vapour Pressure of Parathion and related Compounds.**—*J. Sci. Fd Agric.* **1** no. 11 pp. 344–348, 3 graphs, 20 refs. London, 1950.

The following is substantially the authors' summary. In view of the widespread interest in insecticidal formulations based on parathion, the vapour pressures of the pure material and related compounds likely to be encountered in the commercial product were measured at various temperatures within the range 25–92°C. [77–197·6°F.]. The materials examined were pure parathion (O,O-diethyl O-p-nitrophenyl thiophosphate), two isomers of it (O,S-diethyl O-p-nitrophenyl thiophosphate and O,O-diethyl S-p-nitrophenyl thiophosphate), commercial parathion, which contains mainly pure parathion together with small quantities of various related compounds, O,O,O-triethyl thiophosphate, O,O-diethyl S-ethyl thiophosphate and O-ethyl O,O-bis-p-nitrophenyl thiophosphate. The first four compounds and the last were examined by an effusion technique, and the fifth and sixth in a liquid U-tube manometer. Details of the preparation of the materials are given. The vapour pressures were shown to be low at ordinary temperatures (generally of the order of 10^{-4} mm. mercury, or lower, at 20°C. [68°F.]). The data provided will be of use in assessing the toxic hazards of exposure to the vapour of parathion and related compounds, and the permanence of insecticidal deposits of the material.

Ernould (L.). **Les possibilités de lutte contre la jaunisse de la betterave.**—*Publ. Inst. belge Amélior. Better.* **19** no. 3 pp. 71–138, 2 figs., many refs. Tirlemont, 1951. (With Summaries in Flemish and English.)

Infection of sugar-beet by the yellows virus is widespread in Belgium and other parts of western Europe, and in this paper, which is based mainly on the literature, the author discusses the distribution of the virus, the symptoms produced, and the damage it causes to beet, together with methods of control. These comprise measures designed to interrupt the cycle of plant hosts in which the virus is maintained from year to year, and measures against its Aphid vectors, of which the most important are *Myzus persicae* (Sulz.) and *Aphis fabae* Scop. He reports that schradan is the most promising insecticide yet tested in Belgium against the Aphids [*cf.* next abstract], but that the use of insecticides can give only partial control of infection. The destruction of the winter food-plants of the Aphids is economically impossible, but sowing sugar-beet early and closely and as far as possible from broad beans and beet seed crops and emptying clamps of fodder beet before the first sugar-beet is sown are beneficial. Attempts are being made to develop strains of beet resistant to the disease.

Ernould (L.). **La lutte contre la jaunisse par l'anhydride bis-bis diméthyl amino phosphorique. Résultats d'essais préliminaires sur un champ de betterave sucrière en 1950.**—*Publ. Inst. belge Amélior. Better.* **19** no. 4 pp. 179–188, 7 refs. Tirlemont, 1951. (With Summaries in Flemish and English.)

Investigations on the control of *Aphis fabae* Scop., a vector of sugar-beet virus yellows, were carried out in Belgium in 1950. *Myzus persicae* (Sulz.) was not observed during the experiments. Plots of sugar-beet were treated with 36 lb. per acre of a commercial parathion dust or 108 gals. per acre of a spray containing Pestox 3 (44 per cent. schradan) at 0·75 or 1·25 per cent., with 0·25 per cent. wetting agent, and compared with untreated plots. Treatments were applied on 2nd, 12th or 26th June or 12th July, on the first two or first three of these dates or on all of them. The first Aphid was found on the plants on 1st June, and flights of alates were observed from 8th June. Repeated applications of parathion and single ones of schradan on 26th June or 12th July had no effect on the incidence of the disease, but some reduction was given by single applications of schradan on 2nd or 12th June and still more by repeated applications of schradan, with no difference in effectiveness between the two concentrations. The average percentage reduction in disease incidence for the effective treatments was about 66 on 25th July and 50 on 12th September, and there were increases in root weight and in sugar content.

Ernould (L.). **Le traitement de la graine de betterave contre les larves de taupin. Recherche préliminaire.**—*Publ. Inst. belge Amélior. Better.* **18** no. 3 pp. 95–106, 1 fig., 6 refs. Tirlemont, 1950. **Traitements de la graine de betterave contre les larves de taupin.**—*Op. cit.* **19** no. 4 pp. 189–204, 2 refs. 1951. (With Summaries in Flemish and English.)

It is stated in the first paper that soil treatment with BHC at 0·63 lb. γ isomer per acre has been found in Belgium to protect sugar-beet from damage by wireworms. Germination and plant growth were not affected by rates of application three times as high, but were reduced by 2·5 lb. γ BHC per acre. In a test in 1949, sugar-beet grown in soil treated in spring with BHC at 0·6 or 1·8 lb. γ isomer per acre developed normally, and no unpleasant flavour was detected in the extracted syrup or in the milk of cows that fed exclusively on the leaves and tops for ten days in November. The comparative effectiveness

of seed treatment was tested in the same year in soil with a wireworm population averaging 312,000 per acre. The sowing rate was 25 lb. per acre, and it was found that treatment of the soil immediately before sowing with a BHC preparation, mixed with sand, to give 0·6 lb. γ isomer per acre, and mixing the seed-balls with 0·12 or 0·24 per cent. of their weight of γ isomer in a mixture of 20 per cent. γ BHC and an organic mercury compound or with 0·06 per cent. by weight of γ isomer in 40 per cent. technical BHC and then with 1 per cent. calcium carbonate all increased the stand of plants. The first treatment significantly increased the yield of beet, but the others reduced it, though not significantly. The sugar content was unaffected. All treatments gave effective protection from wireworms, which severely damaged the control plants.

In a further test in 1950, described in the second paper, the seed-balls were dusted with a mercury compound alone and sown at 25–27 lb. per acre in untreated soil or soil treated with BHC to give 0·63 lb. γ isomer per acre ; dusted with 0·3 or 0·6 per cent. of products containing 20 or 40 per cent. γ BHC and a mercury compound and sown in untreated soil at the same rate ; or dusted with 0·6 per cent. of the products containing 20 or 40 per cent. γ BHC and sown in untreated soil at 9 lb. per acre. The wireworm population was about 400,000 per acre. At the higher sowing rate, both soil and seed treatments gave satisfactory protection, and that afforded by the seed treatments increased with the rate of application of γ BHC. They also caused significant increases in stand, the greatest being for seed treatment with 0·3 and 0·6 per cent. 40 per cent. γ BHC. The lower rate of sowing gave a satisfactory stand, but the protection afforded by the seed treatments would not be adequate against a heavy wireworm population and soil treatment would be more reliable. None of the treatments damaged the plants or decreased the yield. Seed treatment with 0·6 per cent. 20 per cent γ BHC is recommended where infestation is expected to be relatively light, as it entails little risk of damage to the plants, whereas further tests are needed before the higher rates can be recommended. If a heavy infestation is expected, soil treatment should be used.

Trentin (A.). **Osservazioni sul trattamento antesemina dei glomeruli di bietola da zucchero con prodotti insetticidi polverulenti a base di esacloro-cicloesano.** [Observations on the pre-sowing Treatment of Sugar-beet Seed-balls with insecticidal Dusts containing BHC.]—*Ann. Sper. agr.* (N.S.) **5** no. 5 pp. 1223–1240, 1 graph, 3 refs. Rome, 1951. (With a Summary in English.)

An account is given of tests made in Italy in 1950 on the effects on plant germination and growth and on damage by soil-inhabiting insects of treating the seed-balls of sugar-beet with BHC before sowing. The seed-balls, either dry (13 per cent. moisture content) or moistened, were mixed with 0·5, 1 or 1·5 per cent. of their weight of commercial powders containing 5, 10 or 15 per cent. BHC (about 17 per cent. γ isomer). Only about half or less of the powder adhered when the seed-balls were dry, but all of it did so when they were saturated with moisture. The seed was set to germinate in the laboratory and sown in field plots on 1st April, and observations showed that the percentage germination was normal for the dry treatments and slightly reduced for those applied to the moistened seed-balls. Germination was usually accelerated by treatment, but there was a reduction in the number of plants obtained per 100 seed-balls in every case and some retardation of growth. The plots were infested by mole-crickets (*Gryllotalpa*), and the treatments at 1 and 1·5 per cent. seemed to exercise some repellent effect on these initially, but damage was serious by 22nd April. A subsequent attack by flea-beetles was as heavy on the treated as on the untreated plots.

Bovey (P.). **Le carpocapse des pommes** *Enarmonia pomonella* **(L.) ravageur des abricots en Valais.**—*Mitt. schweiz. ent. Ges.* **22** pt. 2 pp. 137–172, 15 figs., 16 refs. Berne, 1949. (With a Summary in German.)

Apricots have been grown in the Rhône valley, in the Swiss canton of Valais, since the beginning of the century and have become an important crop. They are intermixed with apple and pear on the valley floor, where attack by *Cydia* (*Enarmonia*) *pomonella* (L.) is slight, but are grown alone, with grape vines under them, on the slopes, where infestation by *C. pomonella* was unknown until about 1930, after which it became serious. Since over half the total crop is grown on the slopes, studies on the bionomics and control of the moth were carried out, mostly in 1943–48.

It was found by the use of bait-traps that the adults usually appeared both in the valley and on the slopes in the last fortnight of May, 21–40 days after the end of flowering on the latter. Graphs are given showing the numbers taken in 1943–48 on apricot on the slopes and also for some years on apple in the valley. The numbers taken per trap were 3–4 times as great on the former as in the latter, and the population reached its peak in late May on apricot and in June or July on apple. The eggs were laid singly or in pairs on the upper or lower surfaces of the leaves or on the twigs, near the fruits but not on them, on calm evenings when the temperature was above 14–15°C. [57·2–59°F.]. The larvae hatched in 8–10 days in warm weather and in 15–16 days in cold, wet periods, and appeared on the slopes at the end of May or the beginning of June. They entered the fruits at points of contact between two fruits, or between a fruit and a twig or leaf, and became full-fed in about a month, but some of them did not have time to complete their development before harvest. Examination of three lots of infested apricots collected between 21st and 28th July 1948 showed that an average of only 39 per cent. of the larvae had left them at the time of picking, so that infested fruits should be destroyed as soon as possible and not left on the ground until after harvest, as is commonly done. The larvae pupated under the bark of the trees or the vine stumps beneath them. There is a partial second generation in most years, and in observations made in 1945 and 1947 it was more numerous on apple in the valley than on apricot on the slopes. The percentages of damaged apricots were variable and ranged from 3·7 to 36 in the different years on the slopes, but rarely exceeded 1 in the valley. Laboratory tests carried out with material from apricot to see whether ovipositing females preferred apple or apricot showed no constant preference for either plant, so that it is unlikely that a biological race adapted to apricot has appeared.

In tests on control on the slopes in 1943, sprays were applied on 10th June or on that date and 30th June, and the percentages of fruits infested after one and two applications, respectively, were 2·2–2·9 and 1–1·7 for 0·05 per cent. DDT in suspension, 1·8 and 0·5 for 0·05 per cent. DDT in emulsified solution, 1·5 and 0·8 for 0·1 per cent. DDT in emulsified solution, 7·2 and 5·2–6·2 for 0·1 per cent. nicotine, and 3 and 4·7 for a combination of nicotine and oil, as compared with 9·8 for no treatment. An emulsified solution of 0·1 per cent. DDT applied once or twice again gave good results in 1945 and 1946. In 1947, when treatment was applied once only, on 4th June, the percentage infestation was reduced from 7·5 for no treatment to 1·5–2 and 0·9 by 0·1 and 0·15 per cent. DDT, respectively, in emulsified solution, and to 5·9 by 0·007 per cent. parathion without a wetting agent. In 1948, when treatment was applied on 28th May, the percentages were 1·3 and 1·5 for 0·1 per cent. DDT as a suspension and an emulsified solution, respectively, 1·1 for an emulsified solution of 0·1 per cent. DDT with 0·025 per cent. parathion, 7·1 for 0·007 per cent. parathion with 0·1 per cent. wetting agent, and 4·3 and 1·3 for 0·04 and 0·08 per cent. parathion, respectively.

Tambs-Lyche (H.). **Aphids on Potato Foliage in Norway. I. With a Supplement on Aphids in Greenhouses.**—*Norsk ent. Tidsskr.* **8** pt. 1–3 pp. 17–46, 5 maps, 24 refs. Oslo, 1950.

In view of the importance of Aphids as vectors of virus diseases of potato, surveys of the species that occur on that plant in Norway were made in 1943–46. Five species were found to breed on it, and maps are given showing their local distribution, together with locality records and notes on their world distribution, overwintering habits, food-plants and migration. *Aphis* (*Doralis*) *rhamni* Boy. was by far the commonest, followed by *A.* (*D.*) *frangulae* Koch and *Macrosiphum solani* (Kalt.) (*Aulacorthum pseudosolani* (Theo.)) ; *M. solanifolii* (Ashm.) (*euphorbiae*, auct.) was less frequent, and *Myzus persicae* (Sulz.) rather scarce. The author states that only two of these Aphids, *A. rhamni* and *A. frangulae*, are known to be holocyclic in Norway ; both overwinter in the egg stage on *Rhamnus*. She considers, however, that *A. gossypii* Glov. is a synonym of *A. frangulae* [so that the potato Aphids identified by her as *frangulae* may have been *gossypii*, since Börner in a recent work (*R.A.E.*, A **41** 32) concludes that *gossypii* is a distinct anholocyclic species that often occurs on potato]. *M. persicae* is potentially the most important of the five, owing to the ease with which it transmits viruses, but it is not sufficiently widespread to be a vector of potato viruses throughout Norway, and recent work has indicated that all five species may be involved in transmission. A list is also given of various other Aphids taken on potato during the work, showing the plants on which they normally breed.

A preliminary survey of the Aphids that occur in greenhouses in winter was made in southern Norway in 1944–45, and the results are given in a supplement. Of the five that breed on potato, *M. persicae*, *Macrosiphum solanifolii* and *M. solani* were all found to be common on various plants.

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Hornstein (I.). **Report on Benzene Hexachloride** [methods of determination of total BHC and of γ BHC in lindane].—*J. Ass. off. agric. Chem.* **35** no. 2 pp. 366–368, 3 refs. Washington, D.C., 1952.

Edwards (F. I.). **Report on Parathion** [methods of determination].—*J. Ass. off. agric. Chem.* **35** no. 2 pp. 381–386, 5 refs. Washington, D.C., 1952. [*Cf. R.A.E.*, A **40** 204.]

Claborn (H. V.) & Beckman (H. F.). **Determination of 1,1,1-Trichloro-2, 2-bis(p-methoxyphenyl)ethane** [p,p'methoxy-DDT] **in Milk and Fatty Materials.**—*Analyt. Chem.* **24** no. 1 pp. 220–222, 7 refs. Easton, Pa., 1952.

Matsui (M.), LaForge (F. B.), Green (N.) & Schechter (M. S.). **Furethrin** [a synthetic mixture of stereoisomeric insecticidal esters of the type of pyrethrin I but with a 2-furfuryl side chain].—*J. Amer. chem. Soc.* **74** pp. 2181–2182, 14 refs. Easton, Pa., 1952. [See *R.A.E.*, B **41** 47.]

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NATUURHISTORISCH MAANDBLAD (MAASTRICHT) : Jaarg. 1 (1912) ; 2 (1913) Nos. 1–4, 6–9 ; 5 (1916) Nos. 3–4 ; 7 (1918) Nos. 6–9 ; 8 (1919) No. 4.

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